California
COYOTE FIRE

National Fire Coordination Study

U.S. DEPARTMENT OF AGRICULTURE/FOREST SERVICE/DIVISION OF FIRE CONTROL

FIRE STUDY REPORT

COYOTE FIRE

LOS PADRES NATIONAL FOREST

CALIFORNIA

1964

ANALYSIS AND REPORT

by

Theodore G. Storey, U. S. Forest Service

Cities of Santa Barbara and Montecito, Santa Barbara County, California; State of California, Los Padres National Forest and Region 5, U. S. Forest Service Cooperating.

June 1965

Reviewed by

M. S. Lowden
W. R. Moore
J. W. Jay
J. H. Dieterich

Prepared by the U. S. Department of Agriculture, Forest Service, Division of Fire Control, National Fire Coordination Study, Washington, D. C. for the Office of Civil Defense under contract OCD-PS-64-229.

FIRE STUDY REPORT

COYOTE FIRE

Santa Barbara, California

1964

CONTENTS

	Page
LIST OF FIGURES	v
I. INTRODUCTION	1
II. FIRE DESCRIPTION	2
LOCATION	2
SIZE AND DAMAGE	2
CASUALTIES	4
FUELS, WEATHER, AND TOPOGRAPHY	5
1. Fuels	5
2. Weather	9
3. Topography	11
CONTROL TIME	11
RATE OF SPREAD	12
FIRE SUPPRESSION FORCES EMPLOYED	12
AGENCIES AND FIRE SERVICES	14
1. Cooperating Fire Agencies	14
2. Cooperating Law Enforcement Agencies	15

Page

3. Other Cooperating Agencies 15

4. Other Cooperators 17

FIRE BEHAVIOR 18

III. ANALYSIS 22

SEQUENCE OF FIRE ACTIVITY 22

MUTUAL AID ARRANGEMENTS 28

1. Pre-Emergency 28

2. Performance in Emergency 30

3. Agency Assignments on Fire 31

4. Handling Requests for Mutual Aid 32

5. Problems Encountered 33

6. Suggestions for Improvement 34

COMMAND ASSIGNMENTS AND ORGANIZATION STRUCTURE 36

1. Pre-Emergency 36

2. Performance in Emergency 37

RESOURCES INVENTORY, DISPATCHING, AND LOCATOR SYSTEM 39

1. Pre-Emergency 39

2. Performance in Emergency 40

3. Arrangements for Keeping Command Informed 41

COMMUNICATION SYSTEMS 41

1. Description 41

2. Effectiveness 41

	Page
FIRE PROBLEMS NEEDING SOLUTION	42
PROTECTING KEY BUILDINGS AND STRUCTURES	44
1. Effective Tactics	44
2. Important Decisions	45
3. Relation to Protecting People in Shelters	47
COST-BENEFIT FACTORS IN STRATEGIC DECISIONS	48
1. Values Sacrificed	48
2. Responsibility for Decisions	50
3. Values Gained	50
STRATEGIC RE-DEPLOYMENT OF FORCES TO PROTECT KEY AREAS	51
1. Description	51
2. Action	51
EMERGENCY EVACUATION OF PEOPLE	52
1. Methods Used	52
2. Responsibility for Decisions	53
3. Problems Encountered	53
SYSTEM AND BASIS FOR ESTIMATING CONTROL FORCE NEEDS	54
1. Description	54
2. Effectiveness	54
3. Problems	54

	Page
CONTROL OBJECTIVES	55
1. Setting Objectives	55
2. Factors Considered	56
3. Success	56
TACTICS AND EQUIPMENT	57
PRE-DISASTER PLANNING AND PREVENTION	58
1. Measures Taken	58
2. Need for Additional Pre-Disaster Action	60
TRAINING OF OVERHEAD AND SUPPRESSION FORCES	61
1. Agencies	61
2. Methods and Equipment	61
3. Training Recommendations	62
FUEL CONDITIONS	63
1. Adverse Effects on Control	63
2. Favorable Effects On Control	64
FATIGUE FACTORS	64
WEATHER FACTORS-SUMMARY	65
1. Prevailing Situation	65
2. Effect On Fire	65
ADDITIONAL UNFORESEEN SITUATIONS	68
IV. CONCLUSIONS	69
V. RECOMMENDATIONS	72

Page

VI. APPENDIX 74

FIGURES

Figure 1 -- Map of Coyote Fire 3

Figure 2 -- Brush and grass fuel type on Coyote Fire 6

Figure 3 -- Residence located in heavy brush being threatened by Coyote Fire 8

Figure 4 -- Burning period map, Coyote Fire 19

I. INTRODUCTION

Between September 22 and October 1, 1964 the Coyote Fire seriously threatened the city of Santa Barbara and adjacent communities situated along the coast of Southern California. Approximately 67,000 acres were burned including 188 structures destroyed or damaged. One man was burned to death, 226 were injured, and $22,000,000 in damages were sustained with suppression costs totalling $2,700,000.

National Fire Coordination Study OCD Project 229, objectives call for specific investigation of selected fires, both current and past, to relate methods and equipment used on large fires during peacetime to potential fire problems associated with nuclear attack. The Coyote Fire was chosen for study because it represents a situation in which several fire suppression agencies under one G.H.Q. were involved in control of a large fire burning both urban and rural areas. (see Appendixes A & B). Urban areas were evacuated ahead of the fire, and were purposely backfired to save larger groups of structures. Air attack was concentrated to save particular structures and trapped persons, and helicopters were used to restage personnel to other areas and transport injured firefighters. Other contemporary fires burning at approximately the same time, including the 71,000 acre Santa Rosa fires to the north, made the situation even more critical from the standpoint of available firefighting resources.

II. FIRE DESCRIPTION

LOCATION

The city of Santa Barbara is situated along the Pacific Ocean in the southeast corner of Santa Barbara County in Southern California. In this vicinity the coastline runs in a due east-west direction. Directly behind the city and paralleling the coast rise the Santa Ynez range of mountains. These mountains are steep and rugged with an average elevation of about 3,000 feet and with one peak rising to an elevation of 4,000 feet. Beyond the Santa Ynez divide is the Santa Ynez River drainage which slopes to the west. The Coyote Fire burned both sides of the mountain range for a distance of 21 miles in an east-west direction and 11 miles north to south. (Figure 1)

SIZE AND DAMAGE

Approximately 67,000 acres were burned on the Coyote Fire. Land ownership of the burned area is as follows: (see Appendix C, Official Fire Report)

Ownership	Acres Burned
National Forest land	46,000
Private and other land inside the National Forest Boundary	17,000
Private and other land outside National Forest Boundary	4,000
TOTAL	67,000

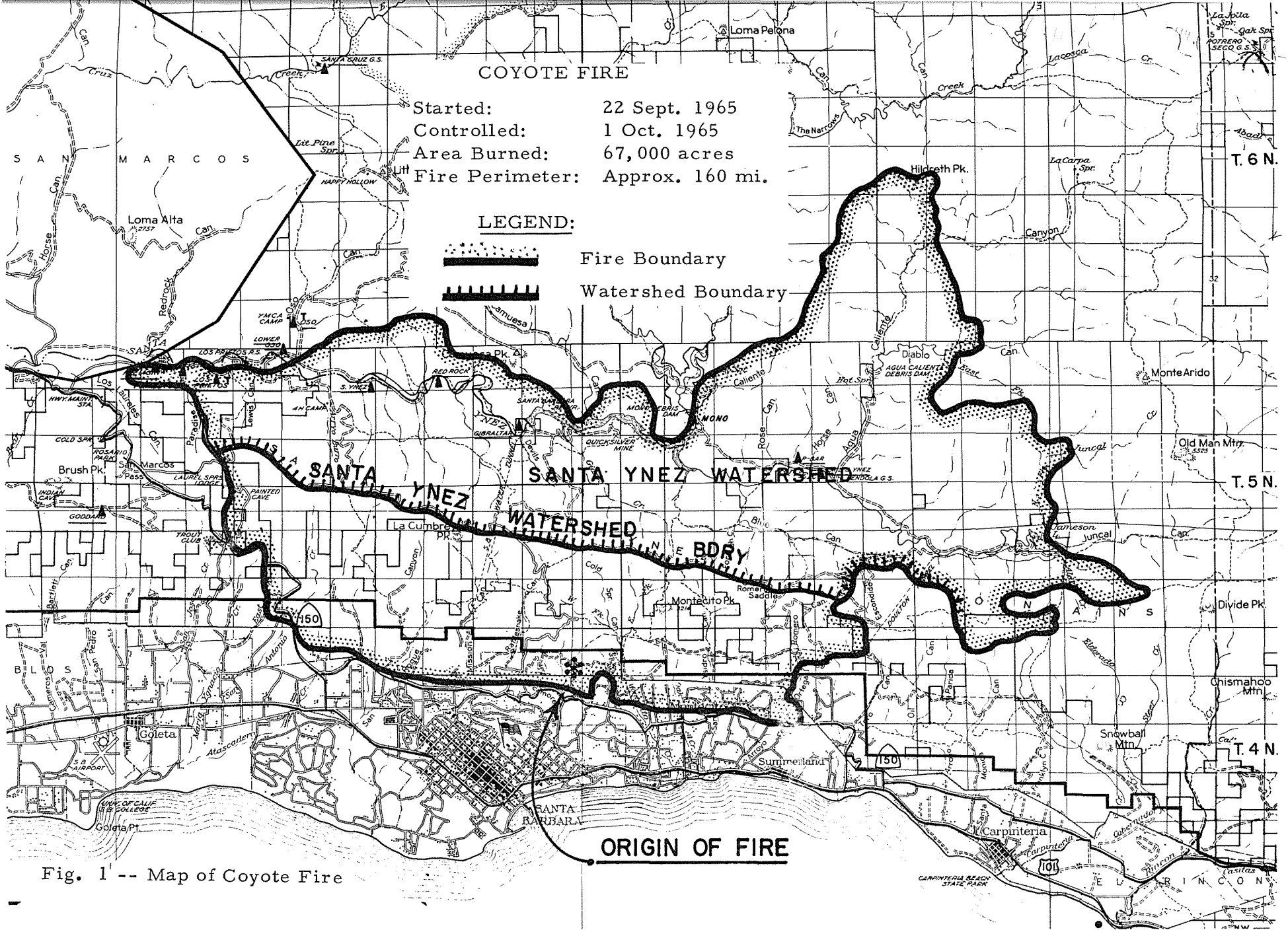


Fig. 1 -- Map of Coyote Fire

Santa Barbara (population 60,000) and the adjacent community of Montecito suffered extensive losses and damage from the fire. Neither downtown area was destroyed, but fire did burn many residences within the city limits and the county just outside. Total damages of approximately $22,000,000 are broken down as follows:

Damage	Amount
To Improvements	$ 3,000,000
To Watershed	15,710,000
Post-Fire Rehabilitation Costs	3,000,000
TOTAL	$ 21,710,000

Improvements damaged included 188 structures (destroyed or damaged), public utility lines, power poles, and roads. The figures do not include indirect losses such as payroll losses, personal property losses, and personal expenses during the evacuation period.

Fire suppression costs were $2,700,000 including $2,500,000 to the Forest Service and $200,000 to other fire agencies and contributions from cooperators.

CASUALTIES

The Coyote Fire was very costly in terms of accidents both to personnel and equipment. There were approximately 227 accidents involving firefighting personnel during the course of the fire. A major blowup, on Thursday, September 24, resulted in one burn fatality and 50 burn cases in two different accidents within a period of approximately one-half hour.

There were no flying accidents among the 15 air tankers and 19 helicopters on the fire.

FUELS, WEATHER, AND TOPOGRAPHY

All three of these factors contributed to the extreme behavior and suppression difficulties experienced on the Coyote Fire.

1. Fuels: The natural fuels in the fire area are predominantly light to heavy stands of mixed brush or chaparral with grass and scattered non-commercial scrub oak trees. (Figure 2) A portion of the Coyote Fire was in the old Refugio burn of 1953. Brush sprouting and regrowth is rapid in the area following fire so much of the fuel was at or near maximum volume for the site at the time of the fire.

   In September the Southern California wildland fuels usually are at their maximum dryness. Grass is dead and cured and green fuels are at minimum moisture content. Samples of living chaparral taken on September 25 in the fire area showed chamise to have a moisture content of about 60 percent and scrub oak about 79 percent. These moisture contents are near minimum for living fuels of these species, and at this moisture level living fuels contribute significantly to the intensity of a fire.

Fig. 2 -- Brush and grass fuel type on Coyote Fire

Natural fuel development during the 1964 fire season in Southern California was particularly heavy. Early winter rains started the brush and grass growing earlier than usual. During February and March, however, dry Santa Ana winds desiccated the brush and killed much of the grass growth. Near normal spring rains started vegetative growth again and increased the amount of grass and other annual vegetation in the chaparral covering the mountain slopes, thus providing abundant fine fuel for ignition and rapid fire spread. The fire potential was increased by the large amount of dead material in Southern California chaparral as a result of more than 15 years of drought.

Urban fuels consisted of residences and outbuildings scattered among the brush and grass covered hills. (Figure 3) Most of the residences destroyed had inadequate clearing between house and brush so fire in the brush was readily communicated to the structure. Flying brands from burning residences intensified the fire suppression problem. Reliable observers reported wood shingles supplied some of the flying brands and wood shingle roofs readily ignited from fire brands.

Fig. 3 -- Residence located in heavy brush being threatened by Coyote Fire.

Because the roads in the area were so narrow, they provided little in the way of effective fuel breaks. There was an existing fuel-break along the Camino Cielo which follows the crest of the Santa Ynez mountains. It consisted of a cleared strip covered with grass much of which was less than 100' wide. The purpose of the break was to slow or stop a fire burning up the mountain, to provide access for suppression forces, and to provide a cleared line to backfire from in a fire emergency. This break was ineffective in stopping or materially slowing the running fire. The reasons were that portions of the break were narrower than standard and it was hit by fire rolling at full speed. The fire also spotted across the Montecito fuel-break situated above the town of Montecito shortly after origin.

2. Weather: Fire danger in the 1964 season, although not marked by extended periods of extreme fire danger, remained consistently high. The combined effect of high fire danger, a large volume of fine fuels, and a large amount of dead heavier fuels resulted in unusually fast spreading fires. Two such fires were the Dry Fire on the nearby Angeles National Forest in early July and the Cozy Dell Fire on the San Bernardino Forest in August.

The general weather pattern that led to the development of the Santa Ana wind condition under which the Coyote Fire burned has been classified as the "Great Basin High - Pacific High." [1/] In North Central California strong winds were reported in Napa, Sonoma, and Mendocino counties beginning on September 20 and reaching a peak on September 22. Several large fires started in this area during that period and seriously threatened the cities of Calistoga, Santa Rosa, and adjacent communities. [2/] A large number of structures were destroyed.

In Southern California strong Santa Ana winds began to appear early on September 22, a few hours before the start of the Coyote Fire. Humidity ranged from 10 to 15 percent. The Santa Ana began to subside on September 24, and sea breezes brought cool, moist air to much of the fire area on September 25. Extreme fire behavior persisted several days after the Santa Ana winds had stopped. Fire weather observations taken at various locations on the Coyote Fire are given in Appendix D.

1/ "Synoptic Weather Types Associated With Critical Fire Weather," by Schroeder, Mark J., et. al. PSW, 1964.

2/ "Santa Rosa Fires," by T. G. Storey, Project 229, National Fire Coordination Study, USDA, Forest Service, Division of Fire Control, 96 pp., April, 1965.

3. Topography: Topography was extremely steep and rough in most of the fire area. Access roads were mostly too narrow for fire suppression purposes and traffic congestion during initial attack was one reason that the fire escaped.

Much of the fireline off the roads was steep and inaccessible to equipment, even bulldozers, and much line had to be put in by hand. The fire suppression efforts were hampered by limited access to the fire perimeter and lack of 4-wheel drive equipment capable of traversing more of the steep terrain.

CONTROL TIME

The Coyote Fire started at 2:02 pm on September 22, 1964 and the final perimeter was reached about 4 1/2 days later at the end of the shifts on September 26. There was open line at this time but no appreciable perimeter spread occurred after this date. Hand crews and tractors continued to construct line until the perimeter had a line on it on October 1, 1964, when the fire was reported controlled. Mop-up operations continued for several days thereafter.

RATE OF SPREAD

There were reports of some extreme rates of spread for short periods during the first four days of the fire. One of the longest sustained runs occurred between 6:00 pm September 23 and 6:00 am September 24. In this 12-hour period the fire spread 10 miles at an average speed of 4/5 miles per hour. There were many cases of fires spread by flying brands. Spot fires as far as 1/4 mile ahead of the main fire front were reported in several instances. The spot fire east of Painted Cave on Wednesday night was 1 1/4 to 1 1/2 mile ahead of the main fire front.

FIRE SUPPRESSION FORCES EMPLOYED

On the peak day there were 3,437 men and 326 pieces of fire equipment on the fire distributed as follows:

Item	Forest Service	Other	Total
Men	2,837	600	3,437
Ground Tankers	94	104	198
Tractors	--	--	94
Air Tankers	--	--	15
Helicopters	--	--	19
		TOTAL	326

The equipment figures do not include the many equipment transports, buses, pickup trucks, ambulances, and other service and supply vehicles, numbering several hundred, in use on the fire.

Eight fire camps were established with two general headquarters (GHQ) located as follows:

Fire Camp	Date Established
Westmont (College)	9/22/64
La Cumbre	9/23/64
Pendola	"
Tucker's Grove	"
Polo Field (Carpinteria)	9/24/64
Los Prietos	9/25/64
Potrero Seco	9/26/64
Mono Flat	9/27/64
GHQ	
Polo Field (Carpinteria)	9/24/64
Tucker's Grove	———

The air attack base was in Goleta, approximately 12 miles airline from the fire center, with alternate bases some distance inland in case Goleta was overcast or fogged in.

Air attack used 15 tankers to drop 600,000 gallons of retardant in 723 trips. Nineteen helicopters delivered more than 600 men to and from the fireline. A few retardant drops were made from helicopters.

AGENCIES AND FIRE SERVICES

In addition to the Forest Service, the agency having primary responsibility for control, several public agencies became immediately involved in the suppression action at the start of this fire. The number of agencies increased as the situation became more complex. Strategy meetings were conducted currently to establish zones of action and responsibility among the various fire and law enforcement agencies involved in an attempt to reduce confusion and avoid omission or duplication of effort. Cooperators and the service and equipment furnished are listed below:

1. Cooperating Fire Agencies
    a. Montecito Fire District - Personnel and Tanker equipment.
    b. Santa Barbara City Fire Department - Personnel and Tanker equipment.
    c. Santa Barbara County Fire Department - Personnel, Tankers and Tractor equipment.
    d. California Division of Forestry - Personnel, Tanker equipment, a fire camp and camp crew, Liaison Staff, Air Tankers and retardants. Assisted in obtaining inmate firefighters, kitchen crews, and other manpower.
    e. Los Angeles County Fire Department - Personnel, Tanker and repair equipment, Air Tankers and retardants and sector teams.
    f. Ventura County Fire Department - Personnel, Tanker and Tractor equipment and Helicopter.

g. Kern County Fire Department - Personnel and Tanker equipment.

h. Los Angeles City Fire Department - Personnel and Tanker equipment.

i. Carpinteria-Summerland Fire District - Personnel and Tanker equipment.

j. California Disaster Office - Personnel, Tanker, Communications and repair equipment and Liaison Staff.

2. Cooperating Law Enforcement Agencies

a. Santa Barbara County Sheriff's Office - Traffic control, and roadblocks, evacuation, arson investigation, policing in fire area for looting and sightseer control, fire camp security and message relay.

b. California Highway Patrol - Traffic control and roadblocks, assisted in evacuation, escorted and assisted in moving tractor equipment and message relay.

c. Santa Barbara City Police Department - Traffic control and roadblocks, assisted in evacuation, policing in fire area and message relay.

3. Other Cooperating Agencies

a. California Department of Corrections - Organized inmate firefighting crews and camp kitchen crews.

b. National Park Service - Helicopter and crew from Sequoia National Park.

c. Federal Aviation Agency - Restricted air space over fire area, relayed messages to and from chartered aircraft, provided close cooperation and priority in air traffic control at Goleta Air Base and office space for Air Transportation Officer.

d. Weather Bureau - Mobile weather units and fire weather forecasters, and special fire weather forecasts as requested as well as current weather forecasts by shift and zone.

e. California Department of Employment - Lists of available manpower and aided in recruiting people for some "hard to fill" jobs.

f. California National Guard - Personnel, transportation equipment and use of Armory for demobilization.

g. U. S. Navy - Personnel and transportation units, tractor equipment and manpower.

h. U. S. Marine Corps - Personnel, transportation and repair equipment, camp crew and manpower.

i. U. S. Air Force - Personnel and transportation units.

j. U. S. Army - Personnel and transportation units.

k. California Division of Highways - Assisted in clearing movement of tractor equipment over highways.

1. Santa Barbara County Parks and Recreation Department - Facilities for GHQ Fire Camp at Tucker's Grove.

4. Other Cooperators

   a. Westmont College - Facilities for Fire Camp.

   b. Santa Barbara Polo Association - Facilities for Fire Camp and GHQ.

   c. Santa Barbara YMCA - Facilities for demobilization.

   d. Many other organizations, such as Churches, Fraternal groups, Schools and Colleges, the Salvation Army and Red Cross. Individuals by the hundreds gave of their time, offered food and supplied much needed encouragement.

Cooperators were too numerous to list individually, but included labor associations, contracting firms, construction companies, ambulance service, hospitals, air and ground transportation, and food and material supply sources. The North American Weather Consultants supplied some of the special weather forecasts mentioned elsewhere in this report.

Santa Barbara Labor Association and the Ventura County Citrus Association supplied organized crews of agricultural workers including Mexican Nationals, for manpower in the early stages of the fire. These men were badly needed for critical agriculture work and the Forest Service released these crews as rapidly as possible, replacing them with other manpower ordered through the Zone and Regional Dispatchers.

Overhead and crews were sent to the fire from all 17 National Forests in the California Region (R-5) and from Regions 1, 3, 4, and 6 (Montana, Utah, Oregon, Washington, Arizona, and New Mexico). The Forest Fire Laboratory of the Pacific Southwest Forest and Range Experiment Station furnished the Fire Behavior Officer and 8 assistants on the fire plus a member of the fire study team.

FIRE BEHAVIOR

The fire started on the early afternoon of September 22 on the outskirts of Montecito and Santa Barbara and burned toward the north and northeast with southwesterly thermal winds. (Figure 4) This despite the fact that there was a strong offshore gradient. The first residences were destroyed at about 3:00 p.m. At about 10:00 p.m. PDT the Santa Ana wind surfaced along the Santa Barbara front--that is, it blew downslope from the north or northeast--and carried the fire downslope into residential areas where it consumed a number of houses. This wind lasted until about 3:00 a.m. on September 23. During the rest of that night the winds along the front were light downslope drainage winds.

Until the afternoon of September 23 the fire was confined to the Santa Barbara front. During the afternoon, however, it crossed the ridge of the Santa Ynez mountains at Cold Springs saddle and slopped over into the Santa Ynez drainage. The fire ran down the north-facing

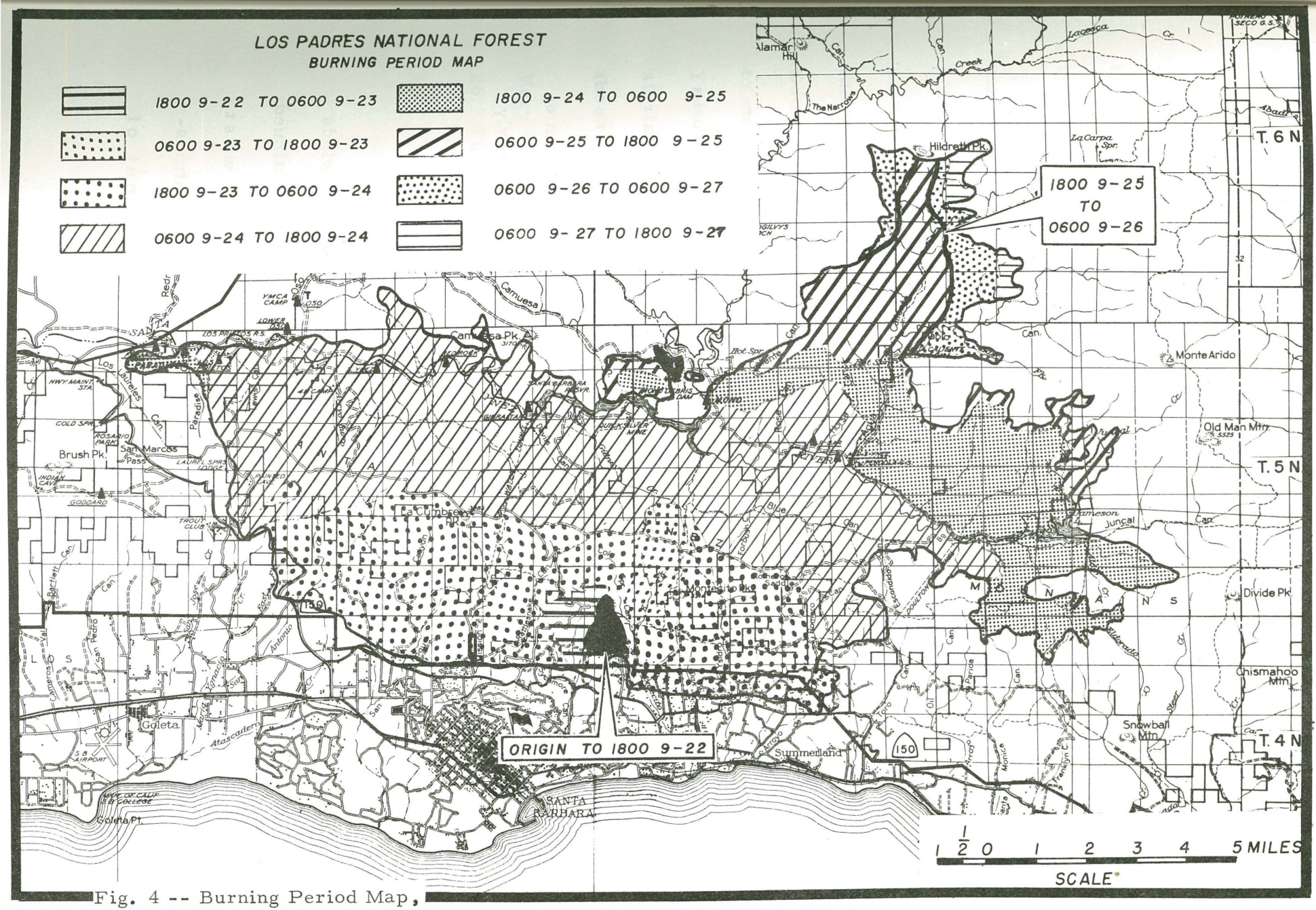


Fig. 4 -- Burning Period Map, Coyote Fire

slope after it crossed the ridge at the saddle. The layer of southwesterly winds became deep enough to carry through the saddle and become downslope winds on the north side. The winds along higher portions of the ridge did not become southerly.

During the early evening of September 23 downslope drainage winds developed along the front and temperatures dropped to the high 70's. About 7:00 p.m. strong northeasterly winds hit the ridge of the Santa Ynez mountains. Between 7:30 p.m. and 7:45 p.m. these winds surfaced along the Santa Barbara front. Temperatures went up to the high 80's and low 90's and humidities dropped to around 14 percent. For a time at Westmont College Fire Camp temperatures alternately went up and lowered 10-15 degrees in seconds as the warm, dry northeasterly wind was detected. The warm air remained at the surface and the northeasterly winds continued to blow until about 5:45 a.m. on September 24. During the nighttime period that the Santa Ana winds surfaced, the fire burned fiercely and spread again into residential areas of Santa Barbara and Montecito areas where it consumed many houses.

Early in the forenoon on September 24 onshore and upslope winds developed first at low levels, while northeasterly winds continued at higher levels. Houses in the Painted Cave area on the west side of the fire were burned in this forenoon period. The atmosphere became more unstable and favored the development of

large convection columns. It was on this day between 12:00 noon and 1:00 p.m. that a number of firefighters were burned - one fatally - in two separate accidents. One was on Cold Springs saddle, the other near Romero saddle on the watershed boundary north of Montecito.

During the night of September 24 the Santa Ana winds did not surface but remained aloft. The fire continued to spread until early morning on September 25 when warm air moved into lower elevations along the Santa Barbara front and humidities rose to 70 percent and higher. During the day moist marine air covered most of the front and began to move up the Santa Ynez drainage also. The upper part of Santa Ynez drainage and the higher elevations generally remained in dry air. Stratus clouds moved inland in late afternoon. The top was about 1,200 feet elevation.

Very little perimeter spread occurred after 12:00 p.m. September 26. The fire was declared controlled on October 1, 1964.

III. ANALYSIS

Early in the event the fire area was declared by the Governor of California to be in a "State of Disaster" under Section 1505 of the California Disaster Act. This made available to the Forest Service much additional fire suppression and rescue assistance within the framework of the Fire and Rescue Service of the State Fire Disaster Plan.

SEQUENCE OF FIRE ACTIVITY

The Coyote Fire started at approximately 2:01 p.m. PDT on September 22, 1964, on the west side of Coyote Road 1/10 of a mile below its junction with Mountain Drive Road (Fig. 1). This was beside a city street in a residential area, about 2 feet outside the city limits of Santa Barbara. The point of origin was on private land outside the official National Forest boundary, but within the contractual protection boundary. A vehicle exhaust spark falling in dry grass was the probable cause of the fire.

The following Forest Service log of early fire activity has been abbreviated, but will serve to demonstrate mobilization.

First Phase (Initial Attack)

September 22, 1964 - 1401 hrs.: Fire discovered by a local resident who immediately reported it by telephone, to the Montecito Fire District Station No. 1. Elapsed time between origin and discovery was between three and four minutes and is well within Regional objectives. The origin was blind to La Cumbre Lookout four air line miles to the northwest.

1403: Fire reported by telephone to Ranger District Clerk-Dispatcher in Santa Barbara by the Mission Canyon Fire Prevention Technician (FPT) who had monitored the Montecito Fire District radio dispatch. The Clerk-Dispatcher immediately notified Forest Dispatcher by radio. The two minute elapsed time from discovery to report meets Regional time standards.

1404: The Mt. Drive crew (3 men) with a Class I Tanker and the Mission Canyon FPT and one fire crew member with a Class III Pumper departed for the fire. They were the nearest to the fire from a travel time and distance standpoint, and were first on the scene. This response was followed closely by Santa Barbara City Fire Department with 1 engine and Montecito Fire District with 2 engines.

1404-1419: The next 15 minute dispatch, handled both by the district and forest dispatchers, included the following forces: All additional district personnel (20 men) and equipment; 3 Class I Tankers, 5 Class III Tankers, 1 Helicopter and Los Prietos Hot Shot Crew: The two Goleta Air Tankers and Lead Plane, 5 additional Air Tankers from South Zone, the preplanned assistance from all the other districts on the forest except the Monterey (they had fire problems of their own), totaling 58 men, 4 Class I Tankers, 3 Class III Tankers. In addition, Montecito Fire District dispatched 4 engines (14 men), Santa Barbara City 5 engines (20 men), Santa Barbara County Fire Department 3 tankers (12 men).

1406: Mt. Drive Crew and Mission Canyon FPT arrived at fire and began live reel and hose lay action. The fire was well established at approximately 1/2 acre, but was still confined to the west side of Coyote Road and south of Mt. Drive. The Mt. Drive Crew attempted to move around the fire and tie it back into Coyote Road. The Fire Prevention Technician moved to the head of the fire to cool it down as it burned into Coyote Road. Fuel was moderate brush with grass.

1408: Fire crowned out through a live oak tree and spotted across Coyote and Mt. Drive Roads. Mt. Drive Crew abandoned action west of Coyote Road and moved to the spots across Mt. Drive. The Mission Canyon FPT also started work on the spots.

1412: District Assistant Fire Control Officer (FCO) arrived and took charge. Fire was spreading rapidly up slope in heavy brush threatening several houses. District Fire Control Officer en route to fire ordered 50 local laborers and two dozers when Assistant FCO reported fire across Mt. Drive.

1416: Santa Barbara City Fire Department engine and 3 men arrived, started work on spots east of Coyote Road.

1418: Additional ground tankers started arriving. Forest Service forces were concentrated on fire above Mt. Drive which was now well established and had started burning the first house, adding to the spotting problems further up the slope.

1420: Air Tankers began to work on spots above Mt. Drive under direction of Lead Plane Pilot and Assistant FCO. Power transmission lines in the area precluded air tankers from pinpointing their normal attack.

1430: Fire was about 15 acres ... five acres of it burning above Mt. Drive. Roads into the area were becoming congested. Additional manpower and equipment were having difficulty in getting to the fire.

1445: District Fire Control Officer arrived and took charge.

1500: Spot above Mt. Drive was approximately 15 acres - four houses were involved and the head of the fire was now burning intensely in dense, mature brush. Flanking action was making good progress. However, it was evident that without slowing the head of the fire the flanking action would never turn the corner.

1510: Effort was made to get tankers and manpower on the Montecito fuel-break at the head of the fire and establish a "toe-hold".

1600: Fire spotted 1/4 mile over fuel-break and it was obvious that a major fire was under way and that a large fire organization would be needed to handle the situation. The Forest Fire Control Officer assumed command and regrouped forces, assigning crews to a Division Boss. Perimeter line construction started.

Had these spot fires not occurred, the Coyote fire would very likely have been controlled at around 15 acres.

Second Phase (Escape from Initial Attack)

September 22 - 1600-1700: Line completed on west flank and across the head of the fire that held until 1700 the next evening. Good progress made on line along east flank; heavy air attack assisting.

1700: Meeting between all agencies again establishing zones of responsibilities; Forest Service to handle all line action above Mt. Drive; Santa Barbara County, City, and Montecito Fire District to handle all structures and all control action below Mt. Drive.

1900: Last air tanker drop made. Good possibility for establishing control at about 300 acres.

2000: Crews making good progress; 1/2 mile of open line. Two hundred and fifty men on the line with additional forces on the way. Fire camp established at Westmont College Athletic Field.

2030: Strong down-canyon (northeast) wind began to blow breeching the west flank. Control quickly reestablished. East flank not controlled and spread continued.

September 23, 1964 - 0600: Approximately 1800 acres burned to date; still spreading.

1000: Fire spread into Cold Springs Canyon proper and toward the Camino Cielo.

1400: Fire crossed the Camino Cielo and started down into the Santa Ynez drainage. Meeting held between the Forest Service and all fire agencies to coordinate action. Force consisted of 10 air tankers, 3 helicopters, 47 tankers, 26 tractors, and 1,300 firefighters.

1800: About 1/2 of the fire perimeter was controlled and line held, this on the west and north sides. Weather forecast and fire behavior forecast favorable; only a 10 percent chance of the northeast winds coming back down to ground level that night.

1830: Another coordination meeting with the Forest Service, Fire Chiefs, Sheriff, and California Highway Patrol held at the fire camp. Action plans and zones of responsibility were discussed and reaffirmed.

1830: Contrary to forecast the northeast winds did develop, the fire came to life and rapidly moved downslope into the developed and residential areas from Toro Canyon (north of Summerland) on the east and across San Marcos Pass Highway on the west (northeast of Goleta). Residents were evacuated and many houses burned. Winds continued through the night.

Fire camps were established at La Cumbre and Pendola.

September 24, 1964 - 0430-0700: Backfiring started along San Marcos Pass Highway toward summit in face of strong northeast wind. Forecast called for continued Santa Ana conditions throughout the day.

0600: Fire 26,000 acres in size and spreading rapidly.

Forces consisted of 10 air tankers, 4 helicopters (one large), 94 tankers, 54 tractors, and 1,400 firefighters.

1000-1400: Backfiring in the Painted Cave area completed to halt westward spread of the fire. Eight residences destroyed. Occupants evacuated.

1330: Southwest winds (opposite of forecast) developed pushing the fire away from the Painted Cave area and across the Camino Cielo along its full length of about 20 miles. Air very unstable.

Two crews along the Comino Cielo above Montecito caught and burned; 27 in one group and 7 in another, one fatally.

1330-1800: Fire crossed the Santa Ynez River at several locations out of control.

The fire was divided into 3 zones each with a Zone Fire Boss and full staff. A General Headquarters (GHQ) was set up.

Additional fire camps were established at Los Prietos, Polo Field, and Tucker's Grove. A GHQ also was set up at Tucker's Grove but soon was moved to the Polo Field at Carpinteria.

Control was established on the west flank after firing out in the Painted Cave area, but fire in the Santa Ynez drainage continued to spread. No further serious threat to Santa Barbara or other residential areas developed.

September 25, 1964-0600: Fire 51,000 acres in size. Forces 10 air tankers, 9 helicopters, 53 tankers, 54 tractors, and 2,367 firefighters.

General fire front moving into the back country toward Hildreth Peak across the Santa Ynez River from Jameson Lake to near Los Prietos.

September 26, 1964-0600: Fire 65,000 acres in size. Forces 11 air tankers, 14 helicopters, 49 tankers, 88 tractors, and 2,837 firefighters.

Heavy air tanker operation in the Hildreth Peak area.

Fire camp and new division established at Potrero Seco. Fire now organized into 4 zones with GHQ.

September 27, 1964-0600: Fire 66,000 acres in size. Forces 10 air tankers, 17 helicopters, 49 tankers, 92 tractors, and 2,577 firefighters.

Fire spread stopped in Hildreth Peak area with assistance of air tankers.

Secondary lines being constructed well beyond fireline.

1500: Zone - GHQ staff meeting on fire action and progress at Polo GHQ with all cooperators and the Chief of the Forest Service attending.

Mono fire camp established.

The fire spread was now virtually stopped and it became a matter of completing many miles of hand line in difficult and inaccessible country. Forces remained at near full strength on September 28 and 29 and then were gradually demobilized. Control was declared on October 1, 1964. Mopup continued for several weeks thereafter.

MUTUAL AID ARRANGEMENTS

1. Pre-Emergency: A large amount of cooperative aid was quickly mustered and brought to bear to suppress the Coyote Fire. Most of this assistance was supplied under existing arrangements and among the fire and police agencies and other cooperators in the area. The Los Padres National Forest has co-op agreements of varying complexity with all of the fire agencies listed in Section II, p. 14 of this report. Many cooperators have similar agreements among themselves. Examples of representative agreements can be found in the Project 229 report on mutual aid arrangements in Los Angeles County, California.[3/]

   These agreements have been developed over a period of many years as a result of common need. They have been improved and refined through frequent use. However, not all of these agreements are formalized in writing and signed.

3/ "Los Angeles Mutual Aid Study," by T. G. Storey and C. L. Harrison. Project 229, National Fire Coordination Study, USDA, Forest Service, Division of Fire Control, 109 pp. March 1965.

A somewhat unique assistance agreement is the Disaster Abatement agreement among protection agencies of the south coast of Santa Barbara County (Appendix E). Parties to this agreement are the Forest Service, Santa Barbara City and County, and the Fire Districts of Montecito and Carpinteria. Listed as facilitating agencies are the County Sheriff's Department, City Police Department, California Highway Patrol, Red Cross, utility companies, transportation companies, newspapers, and radio stations, among others. The agreement specifies a plan of action for emergencies, particularly from fire, which provides for initial attack, setting up a control board of strategy, and providing adequate communications. The Fire Boss feels that cooperation fostered by this agreement greatly facilitated cooperation among the parties involved on the Coyote Fire.

Of course, all fire agencies in the area are parties to the State Fire Disaster Plan of the California Disaster Office (CDO). Civil Defense fire tankers and crews from the southern half of the state were provided under this plan.

Most of the tractors and other rental equipment used on the fire were provided under existing contracts between the Forest Service and the vendors. Usually these contracts are signed each year and

cover the fire season. Most of the air tankers and helicopters were provided in this manner.

The California Division of Forestry (CDF) contracts the job of rural fire protection in Santa Barbara County to the County. However, CDF units from other counties provided a great deal of assistance in the form of personnel, equipment, and service to the Forest Service on the fire.

2. Performance in Emergency: It appears that mutual aid arrangements worked well in the emergency. There was prompt multi-agency response by the Forest, Santa Barbara City, and Santa Barbara County. All three sent reinforcements commensurate with the need as the situation worsened.

Other agencies responded upon request according to plan. Fire and police agencies provided liaison on the Fire Boss' staff and provided communication links.

The Forest Service was in overall command from the start since the fire occurred within their contractual protection boundary. The fire control line and staff organizations built up smoothly as the emergency increased in scope.

Hand crews, tankers, dozers, and air attack were obtained with a minimum of delay from pre-arranged sources through established dispatch channels.

Civil Defense pumpers, repair units, crews, and liaison were provided promptly in the amounts requested. Request channels were followed in most instances.

3. Agency Assignments on Fire: In general, agencies were assigned jobs commensurate with their training and abilities. City fire departments were assigned to urban sections of the line. County fire units were assigned to urban portions of the line or to adjacent rural sections, generally in their normal areas of jurisdiction. The Forest Service handled the rural portions of the fire and over-all command.

Incoming mutual aid units reported to the unit originally requesting them. The two then worked together until their section of line was controlled or a greater need developed elsewhere in which case the responding units were passed along. Responding units were assigned to work with local units whose personnel were familiar with the country.

In Santa Barbara some urban-type fire trucks from adjacent cities were used to fill in behind Santa Barbara's equipment at stations in sections of town remote from the fire action. This released Santa

Barbara's units to work on the fire. Most of this activity was in accordance with existing mutual aid arrangements.

4. Handling Requests for Mutual Aid: Most requests for mutual aid were handled smoothly according to pre-arranged disaster plans.

The Forest Service, Montecito Fire District, and the Santa Barbara City and County Fire Departments were involved immediately because the fire occurred in their joint initial attack zone. When it became evident that a campaign fire was developing, the local agencies involved started requesting mutual aid under terms of their various agreements as follows:

Requesting Agency	Supplying Agency
County of Santa Barbara	California Division of Forestry
County of Santa Barbara	Ventura County
City of Santa Barbara	California Disaster Office
City of Santa Barbara	City of Los Angeles
U. S. Forest Service	County of Los Angeles

Although individual agencies requested mutual aid, they did so, in most instances, only after consultation with the other local agencies represented on the Fire Boss' Coordination Board.

5. Problems Encountered: There were several instances of confusion and misunderstanding in ordering and supplying men and equipment under mutual aid. None appears to have had an adverse effect on fire suppression. Nevertheless, they do indicate areas of mutual aid arrangements that may need improvement.

Requests for CDO pumpers should go from the Forest Service through the California Disaster Office (CDO) Area Fire Coordinator. If the AFC is unable to fill the request, he passes it on to the Regional Fire Coordinator. This insures proper channeling of requests for CDO pumpers in mutual aid situations.

A number of military units from several different home bases were used on the fire. Ordinarily the senior officer present has operational charge of all units in the area. Close liaison must be maintained between the senior officer and fire administrators. Some military units tried to do business direct with their home bases, causing difficult cross-communication problems.

There were isolated cases of units pulling off the fireline without permission and refusing to work. Fortunately these instances were rare. One military unit departed the fire

prematurely without permission. This indicates a need for closer liaison as mentioned above.

The limited range of most urban fire pumpers, because of their dependence on hydrant hookups, was a serious problem in several instances on the Coyote Fire. Line was lost at critical times because these pumpers couldn't get water to the fire.

6. Suggestions for Improvement: Existing mutual aid agreements appear to be adequate both in number and content to handle any emergency as large as the Coyote Fire or somewhat larger. However, more of them probably should be formalized in writing. Unless agreements are spelled out there is a tendency to forget their exact terms, especially in crisis situations. On the other hand, too much formality, particularly in fiscal arrangements, sometimes affects the spontaneity and free flow of mutual aid. Each case should be examined and judged individually.

There appears to be a need for better mutual understanding of dispatch channels to follow in mutual aid situations. People are rushed, communication channels are crowded, and mixups are bound to occur. The answer to this would appear to be joint agency training for emergencies.

Instances of failure of responding units to report in to the requesting unit on arrival at the fire, pulling off the line prematurely, and refusing to work, points up the need for more joint training in these areas. Much of this undoubtedly resulted because the individuals involved did not understand the principles of rural fire behavior, suppression methods, and fire organization. This was also observed on the Santa Rosa fires.

There is a definite need for equipping and training "mountain units" from among the urban fire departments situated in the front country for fire emergencies. Equipment must carry its own water in large quantities and be able to draft water. Joint training with the rural fire services is essential.

Adequate liaison must be provided to responding organizations. Joint agency training, and more specific instructions would help here also.

COMMAND ASSIGNMENTS and ORGANIZATION STRUCTURE

1. Pre-Emergency: Within the Forest Service the organizational structure for large fire suppression is specified in the Manual. The fire commander is designated Fire Boss. He has a staff and line organization under him. Primary staff positions are Plans Chief, Service Chief, and Finance Chief. The primary line position is the Line Boss who has two or more Division Bosses under him, and if an air attack organization is used it is also under his supervision. Each Division is further broken down. Appendix F illustrates the fire organization for the day shift on September 23.

   On very large and complex fires such as the Coyote Fire the organization may be expanded to a General Headquarters (GHQ) organization. Two or more Zone Fire Boss positions, each with a complete line and staff setup are established under the GHQ Fire Boss. The GHQ Fire Boss is also supported by a staff organization. A duplicate set of records for each zone is kept at GHQ. The GHQ Fire Boss is in overall command. Liaison representatives from all cooperating agencies are stationed at the GHQ. The GHQ organization for the day shifts, September 27 is given in Appendix G.

Wherever a fire occurs in the joint mutual attack zone in the Santa Barbara area the ranking man of the "first-in" organization is in command. A representative of the organization responsible for protecting the area takes over when he arrives. As the fire grows in size urban departments are assigned to urban sections of the line, the County is assigned to mixed urban-rural sections and the Forest Service usually handles the wildland portions of the fire. Actually, the Forest Service, by mutual consent, usually assumes command of fires in the suburban areas near the City limits or beyond.

2. Performance in Emergency: Assumption and transition of command was made smoothly and without difficulty. Command of the fire changed 4 times in the first two hours.

From initial attack at 2:06 p.m. September 22, until arrival of Santa Barbara District Assistant FCO, the Mt. Drive Foreman was Fire Boss. District AFCO assumed command as Fire Boss at 2:12 p.m., until arrival of the District FCO.

District FCO assumed command as Fire Boss at 2:15 p.m. until about 4:00 p.m., when the fire spotted across the fuelbreak and it became obvious that a major fire was developing.

The Forest FCO had arrived at the fire about 2:30 p.m. assisting the District FCO in organizing the initial effort. He assumed command at about 4:00 p.m.

On September 23, plans were made to organize the fire into a GHQ with two zones and establish an additional camp at Pendola. Forest Supervisor Hansen assumed command as GHQ Fire Boss, about 10:00 p.m., September 23. FFCO Hickerson assumed command of Zone I, headquarters at Westmont Fire Camp, and all the fire area south of Camino Cielo. San Bernardino N.F. FCO Britton assumed command of Zone II, headquarters at La Cumbre (later Pendola) Fire Camp, and all the fire area north of Camino Cielo.

The fire continued under a GHQ type of organization through control on October 1st.

RESOURCE INVENTORY, DISPATCHING, AND LOCATOR SYSTEM

1. Pre-Emergency: The Los Padres National Forest operates on decentralized dispatch system, whereas most Forests in Region 5 have adopted the centralized dispatch system.

   The 7 Ranger Districts on the Los Padres Forest each have a clerk-dispatcher. The dispatcher for the Santa Barbara District, where the fire occurred, is located in the main Post Office building in down-town Santa Barbara.

   In a fire emergency, the District Dispatcher first dispatches all available resources from the District. If this is not sufficient he will notify the Forest Dispatcher also stationed in Santa Barbara. He, in turn, will dispatch the resources of the Forest. If the Forest cannot supply the resources needed, the Southern Zone Dispatcher in Arcadia, near Los Angeles, is notified. The Southern Zone Dispatcher arranges aid from the other National Forests in the Southern Zone, from the Northern Zone (Redding), and from the California Division of Forestry (CDF). If assistance from other Forest Service Regions is required, the Regional Forest Service Dispatcher in San Francisco is notified. The RFSD will make the necessary contacts to obtain Inter-Regional assistance if needed.

Local City and County fire agencies in mutual aid handle their dispatching needs through their regular dispatch channels. They have communication tie-in with each other and with the Forest Service.

The various dispatch offices maintain complete directories and lists of the manpower and equipment available for them to request and dispatch. Card file systems are the most common means used to record and retrieve data quickly when needed. A variety of maps are used which are mounted on boards so they are readily visible. Complete radio and telephone nets are maintained. Wall charts are commonly used to record names and numbers of men and equipment.

In the fire camps the Forest Service dispatcher has forms for recording information on available men and equipment.

2. Performance in Emergency: Dispatching performed smoothly during most of the fire action. However, the dispatch organization did not build up in proportion to the fire organization early enough to take care of the buildup in business. Consequently, there was a tendency for line units to bypass the dispatch office to get necessary service. This involved the service sections at the fire camps, also.

Locator and inventory systems worked adequately.

3. Arrangements for Keeping Command Informed: Complete records of crews, equipment, and assignments are kept on pre-printed detailed forms by the Plans Section at the fire camp. Thus the Fire Boss could determine at any time the status of the organization.

COMMUNICATION SYSTEMS

1. Description: Three separate radio nets were used besides the Regional air net and the Forest net. The service section of the fire handled their business over radio-telephone, plus 16 miles of helicopter-laid land line. Mutual aid units generally brought their own communications and provided a link at the fire camps and GHQ.

2. Effectiveness: The radio and telephone communications were satisfactory. The copter-laid land line materially assisted Zone II with their business at Pendola Camp. It was installed quickly using a military-type wire feeding device. Existing telephone lines to Pendola were burned out by the fire early in the action.

FIRE PROBLEMS NEEDING SOLUTION

The fire was nearly controlled at three different times during the early stages. Sufficient manpower and equipment were mobilized at the scene of the fire to do the job but lack of sufficient access precluded proper distribution of forces at the perimeter of the fire to be effective within the time available. The three critical instances were:

1. Within the first 10 minutes the fire was almost stopped, but a large live oak crowned, causing spot fires.

2. The fire was lined at 15 acres and spread was stopped but a burning house spread two spot fires across the line.

3. Between 6 and 8 p.m., the fire slowed and a major effort was made to cut off the head. At about 8 p.m., spreading fire outflanked the line and spread rapidly with strong gusty winds. Crews missed closing the line by 25 chains (1650').

Air attack was dispatched on initial attack but approach to the fire was hampered by powerlines and dense smoke so planes were forced to approach too high and at wrong angles to be effective. The possibility of use of helitankers in this kind of situation should be considered.

Study is needed of planning principles for very high hazard, high risk, and high value areas with particular emphasis on the economic balance between road access, helispot access, fuel break access, and preparedness organization needs.

The infrared scanner, while still in the testing phase of development by the Forest Service, was used on the Coyote Fire. The Fire Boss and Plans Chief indicated that timing of flights to get material to plans section for use on the next shift was not right. When infrared fire mapping becomes operational, official guidelines will be issued showing the Fire Scan Officer's place in the fire organization.

It is important for fire command to realize the limitations in the art of forecasting fire weather. Often command wants forecasts for specific small drainages. This is very difficult but there is a need to be able to forecast sudden changes in weather elements, such as wind and humidity. This affects buildup in presuppression forces and specific actions on fires.

Instances were observed of the failure of command to use fire weather and behavior forecast after they were issued.

PROTECTING KEY BUILDINGS AND STRUCTURES

A total of 188 structures, mostly residences were destroyed or damaged on the Coyote Fire. Effective suppression action saved an undetermined amount of property.

Pre-emergency measures that were effective in saving structures were brush clearance around structures, use of fire-resistive roofing and adequate access roads and turn-arounds in brush areas. In general, residential portions of the fire area ranked poor on all three counts. Public Law 643, 1964 requiring brush clearance, and the new Fire Safe publicity program are steps in the right direction but compliance with the law is slow and the prevention campaign has just recently gotten underway.

1. Effective Tactics: Pumping water directly on the roof and walls was the most effective tactic used in saving residences. This had to be done just ahead of the fire and before the structure became too heavily involved. Almost no structures were lost among those that firefighters were able to get to before they were seriously involved. However, it was much more difficult to protect structures where brush had not been cleared.

Many structures were lost because access roads were too narrow to risk tankers and men on them when the fire was close by, even though tankers were available.

A dormitory at Westmont College valued at $200,000 was the most important structure destroyed by fire. The dormitory burned on the second night, September 23-24, after the winds changed to downslope moving the fire into Santa Barbara. Pumpers were massed but efforts to save the buildings were unsuccessful.

Direct air attack was able to save structures at Painted Cave in the forenoon of September 24. This tactic was very effective and shows much promise for use in post-nuclear attack fire suppression and other peacetime fire emergencies. Air attack also was used to save structures in Los Prietos and Paradise later in the emergency. Air attack could not be used directly for saving structures on either September 22 or September 23 because the big runs into populated areas occurred at night.

2. Important Decisions: Structures became involved shortly after the fire started. Suppression forces were in short supply at the time and firefighters were working in the brush attempting to get a line around the head of the fire. Suppression efforts were diverted in an attempt to save the previously evacuated structures.

Had they continued with line building it is possible the fire would have been held at about 15 acres. Forest Service crews as well as urban department crews were involved at the time.

The Painted Cave Road was backfired on September 24 in a successful attempt to stop the westward spread of the fire and to protect the bulk of the 60 homes in that area. Joint consultation between top fire command preceded the decision to backfire. It was recognized that the backfire might endanger a few homes but the risk was judged to be worth the benefits to be gained. Heavy air attack was concentrated on the area following ignition and contributed to saving many homes as the backfire and main fire merged. Eight homes were destroyed by the westward spread of the main fire shortly before the backfire took hold.

Several miles of backfires were used on the Coyote Fire. Much of it was successful in protecting urban areas. Trouble was experienced on the evening of September 23 when a wind shift caused the loss of much line near Santa Barbara. The line had been backfired just prior to the abrupt change in weather. This lost backfire resulted in the loss of several structures.

Following the wind switch on the night of September 22, the fire threatened the Mt. Drive Fire Station located near the fire origin. A pumper was sent back to protect the structures. This action was successful.

3. Relation to Protecting People in Shelters: The urban areas that burned consisted of residences and outbuildings widely-spaced on large lots along narrow, winding, streets with heavy brush between structures. Brush contributes most to the total volume of available fuel in this fuel type. Persons trapped by fire in such a situation would have an excellent chance of surviving if they had access to a closed shelter they could enter briefly until the fire passed over. Fire in brush burns hot but doesn't last long. The structures might burn for longer periods but surrounding brush areas would cool down quickly.

It is doubtful that an oxygen shortage would develop, lethal concentrations of gas would build up, or that air would be heated excessively in the shelter in such a short period. Many cases are on record, including the Coyote Fire, in which firefighters caught in brush areas while attempting to save structures merely stepped inside or behind the house until the fire in the brush passed by. In some instances they were able to save the structure. This becomes more difficult where the brush is very heavy, grows close against the house, and exterior and roof are flammable.

There was at least one instance on the Coyote Fire of residences using prepared shelters to escape the fire. Residents of the Hot Springs Club successfully sought refuge in a shelter dug into a hillside on the Club grounds, even though there was no provision for a supplemental air supply or special ventilation. This shelter, built years ago specifically for this purpose, had a thick masonry entrance and heavy steel door.

More than one instance of residents taking temporary refuge in swimming pools were reported. They simply ducked their heads in the water as necessary when gusts of hot air approached.

COST-BENEFIT FACTORS IN STRATEGIC DECISIONS

Cost-benefit factors entered into many of the decisions made on the Coyote Fire. The most effective method known for determining cost-benefit factors and making key decisions is the informed judgement of a thoroughly trained and experienced fire commander based on intelligence information including good fire weather forecasts.

1. Values Sacrificed: On any project fire, command is faced with decisions where one value must be sacrificed at the expense of another. Decisions of when and where to backfire are the most common. Many such decisions were made on the Coyote Fire including the following:

a. Decision to divert the initial attack crew to protect the structures near Mt. Drive rather than continuing full effort to put a line across the head of the fire.

b. The Painted Cave decision where a backfire was used that would probably destroy a number of homes, but with the planned result of "picking up" the west side of the fire as well as saving a settlement of 60 homes.

Many similar decisions to backfire were made that are not given publicity because only wildland fuels were involved.

There is a natural inclination to try to save high-value property such as the structures in the Mt. Drive incident. It wasn't clear whether this decision was made by the tanker crews themselves or the Fire Boss at the time.

At Painted Cave it was decided that the benefits to be gained from backfiring would be worth the sacrifice of a few houses. It should be pointed out that many additional miles of line were backfired on the Coyote Fire, many of them adjacent to residential areas. These tactics saved many homes. Fortunately none of these other backfires had to be done in situations where homes had to be included in the area to be burned by the backfire as at Painted Cave.

2. Responsibility for Decisions: This rests with the Fire Boss. At Painted Cave the line overhead sized up the situation on the ground and formulated a plan. The plan was presented to the Fire Boss who made the decision to backfire. He did this only after carefully weighing the alternatives and consulting key cooperators. The Fire Boss had unanimous support in his decision by knowledgeable individuals involved.

3. Values Gained: It is almost certain that had Painted Cave Rd. not been fired out, the entire group of homes valued at perhaps $1,000,000 would have been lost. Also, the fire probably would have continued to spread westward burning additional homes and wildlands and requiring further suppression expenditures.

On the other hand, the Mt. Drive decision may have saved a few structures at the expense of 67,000 acres burned and many more structures destroyed.

STRATEGIC RE-DEPLOYMENT OF FORCES TO PROTECT KEY AREAS

1. Description: On Wednesday night September 23 the wind shifted from upslope to downslope driving the fire into urban areas along a front many miles long. Some units that had been fighting the fire in the mountains were pulled back for an all-out effort to save the cities. Control action continued against the rural portions but at reduced strength. Urban units were used in the city defense whenever possible, with some Forest Service units assisting. Fire command had been assembling additional urban fire units for several hours in anticipation of a worse city threat.

   Movement of rural fire forces from the hills to the city defense was orderly and according to plan. Air attack was grounded because of darkness.

2. Action: It was obvious that, in this case, the urban threat was of overriding importance. Thousands of homes were vulnerable. Selected units and crews were ordered to fall back. Orders were passed by radio. Chain of command was followed. The forces involved in defense of Santa Barbara and adjacent cities are estimated at 90 tankers, 50 tractors, and 1,200 firefighters.

Losses were held to 60 homes destroyed and many damaged. This effort was considered quite successful considering the potential threat to homes and communities.

EMERGENCY EVACUATION OF PEOPLE

There were many separate instances of evacuation on the Coyote Fire. All were successful in that no lives were lost among the thousands of residents involved although 188 structures were destroyed or damaged.

The largest evacuation efforts occurred Wednesday night, September 23, when wind shifts caused the fire to threaten the front cities, and on Thursday morning when the residents of the Painted Cave community were threatened.

1. Methods Used: Evacuation of Santa Barbara was handled by the Santa Barbara Police Department, Santa Barbara County Sheriff's Office, and the California Highway Patrol. This was under terms of the Disaster Abatement Agreement (Appendix E). These law enforcement agencies also provide roadblocks, traffic control, and protection against looters.

   Officers moved through the threatened areas issuing requests to evacuate by loudspeakers, bullhorns, and verbally. Local radio stations broadcast the requests. Compliance was good although some persons stayed on to try to save their homes.

The Santa Barbara Sheriff's Office evacuated Painted Cave. More difficulties in getting people to leave were encountered here. All but a few were finally persuaded to leave. Some stayed and a few were able to help save their homes, although at great personal risk. As far as is known no one was forcibly removed in either situation, although this may have been used as a threat.

2. Responsibility for Decisions: The sheriff and representatives of other agencies contributed to a joint decision to evacuate. This was a GHQ multi-agency command decision. Evacuation was done a reasonable time in advance of the fires arrival. Compliance isn't as good if it is attempted too far ahead. There isn't the sense of urgency about it that will prompt people to comply.

3. Problems Encountered: The usual problems of convincing some people to leave their homes when there is a chance of saving it were encountered in both instances.

Access for evacuation and for fire control action was extremely poor. Roads were narrow, one-way, steep, winding, and brush-choked. Frequently brush and tree canopies grew together over the road.

SYSTEM AND BASIS FOR ESTIMATING CONTROL FORCE NEEDS

1. Description: The Forest Service has established systems for estimating control force needs on a fire. Information is gathered by air and ground scouting. Factors considered included present location and size of the fire, fuel type, estimated rate of spread, weather, and equipment available. Computations can be made using tables or a circular slide rule-type calculator. Early in a fire before all aids are available, estimates may be based on experience.

2. Effectiveness: Estimates were generally accurate as long as the weather, particularly wind direction, didn't change. These estimates definitely were helpful in fire control planning. Estimates produced are only as good as the input information. In general, there was adequate air and ground scouting to accurately determine the inputs of fire location and rates of spread.

3. Problems: Unexpected wind reversals sometimes negated carefully drawn control force estimates.

CONTROL OBJECTIVES

On all fires, control objectives are set by the Fire Boss as soon as he is able to size up the situation. Specific objectives are revised as necessary depending on the success of initial attack and subsequent control action. As the fire grows in size the objectives may become more general. For instance on September 24 several thousand acres were burning and there was much open line. The objective set at this time was to hold the fire along the San Marcos Pass Highway on the West and along Camino Cielo on the North.

1. Setting Objectives: Objectives are set by the Fire Boss in conjunction with the Plans Chief (Plan Coordinator in GHQ setup) and Line Boss with other consultation as necessary. When a fire is still small, one man may fill several positions but the organization remains essentially the same.

   Later in the fire more specialists were consulted in making decisions on objectives. However, the judgement of experienced fire commanders remains the most essential factor in setting good objectives.

2. Factors Considered: Factors considered in setting control objectives include location, size, behavior, and rate of spread of the fire, fire weather, fuels, topography, location of natural barriers, values at stake, and type and availability of equipment and assistance. All this information is integrated to arrive at an objective.

   Objectives must be changed to adapt to changing conditions. Adherence to outmoded objectives can be wasteful of time, equipment, manpower, values at stake, and even human lives.

   In a nuclear attack situation, the arrival time of fallout would have to be considered in setting control objectives. Since this period usually is rather short it would appear that incipient fires would have to be attacked more quickly and in greater force than at present. After a maximum of perhaps one hour, depending on the attack, suppression forces would have to seek shelter from fallout. It might not be safe for them to emerge for several days thereafter.

3. Success: Objectives established at various points during the Coyote Fire appeared reasonable. Objectives were changed promptly in response to changing conditions.

TACTICS AND EQUIPMENT

Tactics consisted primarily of a combination of direct and indirect attack on the head, flanks, and rear of the fire. Indirect attack was accomplished using hand-constructed line, tractor-built line, retardant line laid by aircraft ahead of the fire, and backfired lines. Direct attack on the fire included the techniques of retardant drops directly on the fire, water applications by tankers, and lines built by hand at the fires edge. Existing roads stopped certain portions of the fire without supplemental widening.

During the main urban threats, pumpers were massed at the urban fringe and were used primarily to protect individual structures as the fire approached and passed by. Some backfiring out along roads was done as the fire swept into town. These lines were rather ineffective in most areas and the fight resolved into a series of individual actions with tankers attempting to save structures while the fire burned by in the adjacent brush.

Air attack was successful in protecting key areas, structures, and, in one case, trapped firefighters. Retardant drops saved many homes in the Painted Cave area Thursday morning September 24.

The Gibraltar Saddle rescue operation that same afternoon was materially aided by air attack. A flareup had trapped a crew of fire-fighters. Concentrated air attack on the spot held the fire in check until ground units could bring out the burned and injured men. Helicopters landed nearby to carry them to hospitals.

The firing-out operation at Painted Cave where air attack was used to protect residences until the fire was safely past is a technique worthy of further study for possible application in other fire emergencies. Tactics used by air attack at Gibraltar Saddle to protect life also has application in civil defense.

PRE-DISASTER PLANNING AND PREVENTION

1. Measures Taken: In the Santa Barbara area each agency and fire service maintains an organization capable of handling the ordinary fire business. None has the resources to cope with disasters without assistance. As explained earlier the fire services have banded together to assist one another in these emergencies, under mutual aid agreements.

   Agencies do not hold joint training sessions; however, each appears to have a good understanding of the problems, capabilities and resources of the others.

The urban fire departments maintain fire stations in the "front country" sections of town. Some are equipped with 4-wheel drive equipment with large tanks that are useful in hilly suburban sections. Most personnel assigned to these stations have some rural fire control training and experience.

County departments generally are staffed, trained, and equipped to fight fire in the brush.

The Forest Service has installed a pre-attack system on most of the Los Padres Forest. It consists of prepared and permanently marked locations of water sources, tanker fills, equipment parking, tractor unloading, turn-arounds, fuel breaks, access roads, and trails. This system has proved very helpful in fire emergencies.

The Forest and County now have a fairly complete system of fuel breaks, roads and trails. Most of the net is marked and mapped for quick location and is well maintained.

For years the City and County have been fighting a losing battle to limit building in the mountainous sections, promote use of firesafe construction, and to get homeowners to maintain firebreaks between structures and the surrounding brush and trees. Existing ordinances have been inadequate. California Public

Law 643 passed in 1964 is more specific and provides stiffer penalties for non-compliance. The situation should improve when this law is fully implemented.

2. Need for Additional Pre-Disaster Action: Additional prevention personnel are needed to carry out the provisions of Public Law 643.

Since the Coyote Fire the County has adopted the Uniform Fire Code. The County also has passed (December 3, 1964) an ordinance, County Ordinance No. 1600, relating to fire resistant construction and other protection for buildings in high hazard areas.

The Forest Service has allotted money for a "crash" program of type conversion and fuel break construction within the burn providing for construction of 50 miles of fuel break and 7,500 acres of type conversion.

The Santa Barbara County Board of Supervisors has appointed a committee to study the possibilities for controlled burning of vegetation as a brush removal and fire prevention measure.

Some people who live in the fringe areas of the high hazard brushlands do not realize they may be vulnerable to fire loss. The Forest Service has undertaken to notify these people in writing of their peril. This applies to occupancy within National Forest protection boundaries only.

TRAINING OF OVERHEAD AND SUPPRESSION FORCES

1. Agencies: Each fire agency in the Santa Barbara area conducts intensive training in their areas of primary responsibility. City departments train primarily in structural fire control, the County in structural and rural fire control, and the Forest Service primarily in rural fire suppression.

   Selected City crews attend brush firefighting schools conducted by the County, State, and Forest Service. Selected Forest Service crews receive training in structural firefighting. However, the bulk of the fire training is done within the agency.

   There is no joint agency training for large fire emergencies in the Santa Barbara area. As indicated above there is joint training of small groups of personnel for specific facets of the job only.

   California Disaster Office equipment and personnel do not participate in Forest Service rural fire schools.

2. Methods and Equipment: Training consists of instruction in the classroom, in the field, and continually on the job. Qualified instructors, modern training aids, and methods are used. The Forest Service conducts within-service schools in all aspects of

large fire management including categories of line and staff functions, dispatching, and air attack. They do not conduct actual full-scale mock field problems. Other agencies do not participate to the full extent they do on actual large fires. Police, institutional representatives, and similar cooperators do not train with them on a routine basis. The training each agency conducts prepares its personnel very well for their routine fire business. Problems arise in joint agency fire emergencies such as the Coyote Fire where all agencies must work together, frequently out of their normal environment.

The Coyote Fire revealed that urban crews may lack sufficient training in rural fire control and that their equipment is unsuitable for use off the road and away from hydrants. This seriously restricts their range and effectiveness in rural-urban fire threat situations.

3. Training Recommendations: Joint agency training for large fire emergencies should be explored. All pertinent fire, Civil Defense, and law enforcement agencies should participate. Conditions should be as realistic as possible.

FUEL CONDITIONS

1. Adverse Effects On Control: The hazardous condition of rural and urban fuels was largely responsible for the Coyote Fire igniting, escaping initial control, and for its subsequent spread.

   The two most damaging fires in California in 1964 involving the Forest Service (the Coyote Fire and the Cozy Dell) started in grass fuels near road edges. Both might have been prevented by good roadside hazard reduction work.

   After escaping initial attack the Coyote Fire quickly involved several structures. These structures had inadequate clearance from the brush, were sub-standard construction, and access was inadequate. Brands from the burning structures carried the fire across the Montecito fuel break, initiating the campaign phase of the fire.

   In the subsequent cases of urban threat similar problems were experienced. Fire was readily communicated from the brush to structures and back to the brush. Combustible roofs produced brands that carried fire up to 1/4 mile or more to ignite brush and other structures. Wood roofs ignited readily from brands of all types.

Most roads on the city fringe were too narrow to permit safe backfiring when use of this tactic was indicated. Roadside brush made many roads too dangerous to risk fire equipment on them. This caused many houses to be destroyed that otherwise might have been saved.

2. Favorable Effects On Control: Fuel breaks that had been built to standard stopped, or materially slowed the fire, at least temporarily, in several areas. Houses with proper clearance from the brush survived the fire much better than those surrounded with brush. Where adequate access was provided, firemen could enter and pump water on the structures.

FATIGUE FACTORS

Fatigue was no particular problem among commanders or other overhead on the Coyote Fire. Because of adequate numbers of overhead, they were able to get sufficient rest.

Use of helicopters to move men to and from the line and for scouting contributed greatly to minimizing fatigue problems at all organizational levels throughout the action.

Firefighters were rotated at adequate intervals so they had proper rest.

WEATHER FACTORS-SUMMARY

Areas that fall within the marine air influence, such as Santa Barbara are very complex as to weather pattern. It is particularly difficult to forecast the local weather situation for specific elevations in the mountains and for specific small drainages. Yet, this must be attempted because these weather forecasts and the fire behavior forecasts derived from them provide vital inputs for decision making by the fire commander.

1. Prevailing Situation: The weather that prevailed during the fire was generally unfavorable from the standpoint of fire behavior and fire suppression. The wind was strong, frequently gusty, and changeable. Humidity was persistently low which enhanced fuel dryness. Temperatures were generally high. However, it was the sudden, unexpected reversals in wind direction which caused the biggest problems in fire suppression. Some of the fire command felt that these changes were not forecast accurately enough.

2. Effect on Fire: There were at least three critical wind reversals on the Coyote Fire. The first occurred during the first night, September 22 when the wind changed suddenly from upslope to downslope carrying the fire over the west and south flank into populated areas of Santa Barbara.

The second case occurred about the same time the following night, September 23, but with more disastrous results. The fire was much larger this night when the wind switched so the fire was spreading along a much broader front when it swept into the cities. It also persisted for a longer period of time.

The third event, which involved primarily the fire situation in the Painted Cave area, occurred about noon September 24. At this time the wind, which had been blowing steadily from the northeast, switched suddenly 180 degrees to the southwest. This caused the head of the fire which was about to engulf the homes in Painted Cave to become a backing fire. This fortuitous event, combined with prompt backfiring of the Painted Cave Road, saved all but a few houses in the area and permanently halted the fire's westward spread.

Fire Weather Forecasts and Fire Behavior Forecasts for the second and third critical periods are included in Appendix H. The original Fire Behavior Forecast for the night of September 23 mentioned the possibility, (labelled a caution), that the strong Santa Ana winds from the northeast would surface again that night. While only a 10 percent chance was given for this to happen, the wind shift occurred and as observers on the ridges detected the onset of the wind switch they immediately notified the Fire Behavior Forecaster.

He prepared an amended forecast and promptly notified the Fire Boss at 7:30 p.m. Crews on the line were alerted at once.

The Fire Behavior Forecast for the day shift September 24 in the Painted Cave area indicated westerly spread at high levels, the general level of Painted Cave. The forecast didn't mention that upslope winds were a possibility although they were predicted for adjacent sectors. Southwesterly winds did develop starting about noon.

The above forecast strongly indicated there would be generally erratic fire behavior during the day. Erratic fire behavior was partially responsible for trapping the two fire crews in the early afternoon of September 24 at Gibralter Saddle. A number of fire-fighters were burned, one fatally, in the two seperate incidents.

The Fire Weather Forecast units were provided by the U. S. Weather Bureau and the Fire Behavior Forecast unit provided by the Riverside Forest Fire Laboratory. The services provided by these units were vital to the suppression effort. They would be equally valuable for coping with the fire problem following nuclear attack.

Fire weather forecasting and fire behavior forecasting involve many difficult problems. Increased research effort in these fields is urgently needed.

ADDITIONAL UNFORESEEN SITUATIONS

An unexpected problem involving movement of equipment developed during demobilization of forces after the Coyote Fire was controlled. Many overweight tractors were used on the fire. These were allowed on the State highways to get to the fire, but trouble developed with highway officials in getting them home. Rulings by highway officials to the effect that after the fire was under control the emergency no longer existed caused long delays and added expense getting such equipment back to home base. This points to possible problems in other sections of the country but this would probably not be a problem during a nuclear emergency. Negotiations have been started with State officials to arrange for blanket permits for use of highways in emergencies.

There seems to be a serious question concerning how many access roads are needed or can be afforded. The problems evolve around a proper balance of access, manpower, prevention, machinery, fuel treatment, and other fire control facilities and aids. It seems that some careful cost-evaluation studies on these matters are needed. Operations research and system development techniques might be applicable to this problem.

IV. CONCLUSIONS

From the analysis of the Coyote Fire, we can conclude or assume the following:

1. Pre-emergency arrangements should provide for; (a) mutual aid, (b) command assignments, (c) evacuation measures, (d) other details for emergency operations.

2. The effectiveness of multi-agency operations in emergencies is tied closely to how well cooperators work together. How well they work together depends a great deal on how much they train together and/or how often they work together.

3. The Coyote Fire Study shows the need for better dispatch systems and aids to handle channeling of requests, orderly requisition of supplies, assignments, and multi-agency situations.

4. Command and Service personnel must have the ability and training to plan ahead in emergencies. Otherwise, resources will not be on hand when needed.

5. Existing systems for location and inventory of resources work satisfactorily. Competent, experienced dispatchers are essential for existing systems to function properly.

6. Cooperating agencies should if possible, be assigned jobs that are in line with their past training and capabilities. If cooperating agencies are to be used in other capacities, they will need pretraining to do safe, effective work.

7. Procedures for reimbursement for use of Civil Defense fire equipment and other borrowed equipment should be clearly specified in pre-emergency arrangements in order to avoid mixups when the crisis occurs.

8. Emergency communication systems including land lines laid by helicopter are needed to handle the traffic in a large fire situation. Traffic on primary radio networks must be relieved and burned out line replaced.

9. The infrared fire mapping scanner proved to be a useful tool on the Coyote Fire.

10. Key buildings of smaller size can sometimes be protected from fire by conventional tanker and engine equipment with normal-size crews provided an adequate water source is available.

11. Air attack with retardants is effective in protecting individual residences from fire in situations untenable or inaccessible for ground forces.

12. Most persons will voluntarily evacuate their homes when threatened by fire if the need is made evident to them; however, many individuals will insist on staying, in an attempt to save their homes.

13. Private citizens will assist one another in fighting fire and otherwise helping in emergencies even when they have no personal or financial interest in the outcome and are themselves in danger.

14. It is important to set clear control objectives in a fire emergency. This forms the basis for estimating resource requirements.

15. Volunteers can be integrated into the suppression operation in fire emergencies if they can be given reasonable on-the-job training prior to assignment.

16. Adequate access for equipment and personnel is vital in order to suppress fires promptly. Obstructions include inadequate roads, thick brush, and traffic congestion (vehicle and pedestrian). Power lines, terrain, and smoke can seriously limit access for air attack.

17. Logistics and action timing capable of controlling fires in peacetime may not be realistic where fallout is involved.

18. Much needs to be done in the way of fuel treatment and hazard reduction to make our urban and rural areas less vulnerable to fire. Fuel breaks and roads are effective as fire breaks when wide enough for backfiring and when so used.

19. Fatigue among fire command can be a problem This would be more likely in emergencies much larger and widespread than the Coyote Fire and in nuclear attack situations where replacements might not be available.

20. Fire Weather and Fire Behavior Forecast teams provide a vital service to the fire command in fire emergencies.

21. In addition to current use, helicopters show great promise for use in large fire emergencies resulting from enemy attack.

22. Urban fire services in areas of rural-urban interface need more training and equipment for fighting fire in the brush and off the road. The same may be said for the rural fire services in becoming more familiar with urban firefighting methods.

23. Humans can survive fire in dense rural-urban fuel mixes provided shelter is immediately available that will resist fire for a few minutes until the rural fire passes.

24. Effective command with supporting staff was established early in the Coyote Fire emergency and was maintained throughout the fire.

25. The dispatching system on the Coyote Fire is a good example of a flexible system that can expand and shift from district, to forest, to zone, to region, as the problem enlarges.

26. The Coyote Fire started from a single ignition which was discovered quickly and fire forces responded with an all-out initial attack. Yet the single ignition escaped and spread to become a project fire. Obviously if nuclear warheads were detonated under similiar conditions of fuel and weather, numerous fires would start and spread to form large fires of unmanageable proportions. Control would have to be selective and the objectives would be to protect lives and specific key resources and improvements.

27. The threat to urban areas from uncontrolled wildland fires is substantial when conditions of fuel approximate those experienced in the Coyote Fire.

V. RECOMMENDATIONS

These recommendations are concerned with problems, that if solved, would increase effectiveness and contribute toward a nationally coordinated fire system.

1. Encourage the establishment of fire control mutual aid arrangements, including strengthening of existing ones, to cover broad geographical fire problem areas in the United States.

2. Encourage and support joint agency training for a large fire emergency. Joint training is the key to effective action.

3. Include law enforcement departments and the military in joint training.

4. Further integrate air attack with fixed-wing aircraft and helicopters into plans for disaster fire suppression. Air attack alone can protect certain types of key structures.

5. Encourage and promote training and equipping of small fire brigades composed of residents. Plan to integrate them into the large fire suppression picture.

6. Plan for integrating improved procedures for scouting and fire intelligence into command and mutual aid arrangements. The infrared fire mapping scanner is an example of this advanced equipment.

7. Consider using or adapting for multi-agency training in large fire emergencies, the organization and command procedures developed over the years by the Forest Service.

8. Promote, as necessary and proper, means for fuel treatment for hazard reduction to make our urban and rural areas less vulnerable to fire.

9. Encourage and promote the use of fire weather and fire behavior forecast teams on all large fire emergencies.

10. Encourage increased training in rural fire suppression for urban fire crews, and urban fire suppression for rural crews, located in urban-rural fringe areas.

11. Conduct studies of the proper balance between access roads, fuel treatment, auxillary water sources, prevention, manpower, and machinery for fire control.

12. Coordinate Civil Defense and fire services so that fire defense utilizes the capabilities of both during disasters.

13. Inventory available personnel that are working in organized labor, and have the stamina and training to work effectively in fire control.

14. Use the Coyote Fire as a case example for training fire staff and Command for Nuclear Fire Defense.

VI. APPENDIX

Appendix A. --Conduct of Study

B. --Individuals Interviewed

C. --Individual Fire Report

D. --Fire Weather Observations for September 23 and 24, 1964 on the Coyote Fire

E. --Disaster Abatement Agreement

F. --Fire Organization, Coyote Fire

G. --General Headquarters (GHQ) Organization, Coyote Fire

H. --Selected Fire Weather Forecasts and Fire Behavior Forecasts, Coyote Fire

I. --Documents and Records on File

APPENDIX A

CONDUCT OF STUDY

APPENDIX A

CONDUCT OF STUDY

The study was conducted by a single analyst that combined a complete review of the pertinent file material with a series of interviews with key individuals, and a visit to the site of the fire. Theodore G. Storey, Fire Analyst, with OCD Project 229 stationed at the Forest Fire Laboratory in Riverside, California was assigned to make the study by W. R. Moore, Project Chief, in Washington, D. C. about April 1, 1965.

Record material from the Forest Service Regional Office in San Francisco, the Los Padres Supervisor's Office in Santa Barbara, the Forest Fire Laboratory in Riverside, and personal files of individuals working on the fire were made available for the study, as well as portions of personal files of some of the individuals that were interviewed.

The Coyote Fire is famous in recent California fire history and as a result is well-documented in reports and accounts of the fire action prepared by agencies involved and other interested individuals. The fire received extensive coverage in national magazines, and at the time received nationwide press coverage when the city of Santa Barbara and smaller communities were threatened along a broad front.

Most of the material reviewed by the analyst is in good general agreement concerning direct action on the fire, time sequence of events, and utilization of suppression forces. The review and analysis of available knowledge that is not always available through interviews, especially when a period of time has passed since the actual fire experience. Interviews provide impressions of past action and reveal certain parts of the overall fire suppression job.

As a direct result of the Coyote Fire and the Santa Rosa fires, the California State Senate Fact Finding Committee on Natural Resources convened a hearing in Santa Barbara October 15, 1964. The analyst attended this hearing and information from the transcript was utilized for the present report. The Senate Committee Report and other pertinent reports used are referenced in Appendix P, Documents and Records on File.

The analyst also studied and reported on the Santa Rosa fires currently for Project 229. These fires were still burning when the Coyote Fire started. Each had an influence on the other through their drain on equipment and manpower reserves.

APPENDIX B

INDIVIDUALS INTERVIEWED

APPENDIX B

INDIVIDUALS INTERVIEWED

Name	Position During Fire	Regular Position
C. M. Countryman	Member, Fatality Investigation Team, Coyote Fire	Project Leader, Fire Behavior, Fire Lab. PSWF&RES, Riverside.
M. J. Schroeder	Fire Behavior Officer, Coyote Fire	Project Leader, Fire Meteorology, Fire Lab. PSWF&RES, Riverside.
H. W. Mansfield	Air Attack Boss, Coyote Fire	Assistant Fire Control Officer, Los Padres N.F. Santa Barbara
W. H. Hansen	Fire Boss, Coyote Fire	Forest Supervisor, Los Padres N.F., Santa Barbara
C. W. Hickerson	Zone Fire Boss, Coyote Fire	Fire Control Officer, Los Padres N.F., Santa Barbara
C. Ulrey	Calif. Disaster Office Representative, Fire Boss Staff, Coyote Fire	Field Representative, California Disaster Office San Bernardino

APPENDIX C

INDIVIDUAL FIRE REPORT

USDA-FOREST SERVICE

INDIVIDUAL FIRE REPORT

RANGER FIRE NO.	NAME OF FIRE
9	Coyote
REGION FIRE NO.	**SIZE CLASS**
	E

MANDATORY ITEMS: Class A- Items 1-39 Class B- Items 1-49b Class C, D and E- Items 1-53

This fire is being reported by the State as its fire. *(Check one)* [X] Yes [ ] No

1. State [2-3]	2. County	3. Forest [4-5]	4. Ranger District [6-7]	or LUP [6-7]
California 4	Santa Barbara	Los Padres 7	Santa Barbara 54	

5. Supervisor Fire No. [8-10]	6. Month [11]	Day [12-13]	Year [14]	7. Size Class [15]	8. General cause [16-17]
29	9	22	4	E 5	Resident 68

9. Specific cause [18-19]	Other (Unknown) 8	27. Burning index / Buildup index [54-57]	12 / 514	1214
10. Class of people [20]	Local Perm 5	28. Character of fire on arrival [58]	Spotting	4
11. Fire started on [21]	Other Lands inside Forest Service Protection Boundary 2	29. Topography - vicinity of origin [59]	Lower 1/3 of Slope	5
		30. Slope [60]	20%	2
		31. Aspect [61]	S	2
		32. Elevation [62]	790'	1
		33. Cover type - vicinity of origin [63-64]	Brush on Non-Timber Soil	21
		34. Specific fuel - point of origin [65]	Grass and Stubble	0
		35. Fuel type prevailing on area - origin to attack [66-67]	Moderate Chamise and Chaparral	23
		36. Perimeter increase in chains per hour - discovery to attack [68-70]	Unknown	x
		37. Forward rate of spread in chains per hour - discovery to attack [71-72]	3 Chains - 5 Minutes	36

	D. S.	DATE	HOUR	ELAPSED TIME Hours [22-23]	Min. [26-27]
12. Origin *(Check one)*	[ ] Known [X] Guess	9/22	1357	13 x	
13. Discovered (Item 13 minus 12)		9/22	1401	[24-25]	4
14. Reported (Item 14 minus 13)		9/22	1403	[28]	[29-30] 2
15. Departed		9/22	1404		
16. First attack (Item 16 minus 13)		9/22	1406	[31-32]	[33-34] 5
17. Travel time (Item 16 minus 15)				[35]	[36-37] 2
18. First reinforcements (Item 18 minus 16)		9/22	1416	[38]	[39-40] 10
19. Fire controlled (Item 19 minus 16)		10/1	1800	[41-43] 220	
20. Fire mopped up (Item 20 minus 19)		10/10	1800	[44-46] 216	
21. Fire out		10/28	1600		

22. Discovered by (Class)	Location	[47]
Other (Resident)	Scene	9
23. Reported to (Class)	Location	[48]
Suppression Crew	Mt. Drive Station	2
24. First attack (Kind)	Amount	[49-50]
Ground Tankers	5	35
25. First reinforcements (Kind)	Amount	[51-52]
Ground Tankers	3	33
26. Hour control zone		[53]
15 Minutes		1

38. Map record:

Scale: _____ inches = 1 mile

See Attached

39. Location description

a. Township 4N	[73-75] 41
b. Range 27W	[76-78] 272
c. Section 1	[79-80] 1
d. Mer. SBBM	

Alternate description: Use for land not covered by GLO survey

e. Latitude	[73-76]
f. Longitude	[77-80]

40. Cover type prevailing on burned area [18-19]	Brush 2	46. Man-hours to control [38-41]	253,200 253200
41. Area when discovered [20-21]	.1 0	47. Mopup in percent of total effort [42-43]	25,380 9
42. Area when attacked [22-24]	.5 0	48. Percent of perimeter worked by:	
43. Area when controlled [25-29]	67,000 67000	a. Ground tankers and pumpers [44]	198 - 1685 1
44. Perimeter in chains when controlled [30-33]	(12,800 Tot Chns) 9999	b. Ground machines [45]	92 - 520 0
45. Maximum number of line workers [34-37]	2570 2570	c. Aerial attack [46]	588,200 - 6400 5

5100-29 (1/60)

SUMMARY OF FIRE DAMAGE Class B fires: Items 49a and 49b mandatory. Class C and larger: Items 49a through 53 mandatory.	N.F. LANDS (1)		OTHER LANDS INSIDE F.S. PROTECTION BOUNDARY (2)	
	Acres or Dollars	Code Column	Acres or Dollars	Code Column
49. Acres burned				
a. Noncommercial forest land		[47-51]		[52-56]
63,000		46000		17000
b. Commercial forest land		[57-61]		[62-66]
c. Seedlings and saplings destroyed				
50. Volume (MBM) of timber destroyed (convert cords to MBM)		[67-71]		[72-76]
51. Value of timber damaged or destroyed				
a. Merchantable timber				
b. Seedlings and saplings				
c. Other timber				
d. Total timber damage (a to c, incl.)		[18-22]		[23-27]
52. Value of other damage (nontimber)				
a. Watershed		[28-32]		[33-36]
$14,476,151.00	9,231,651	92317	5,244,500	4244 9999
b. Recreation		[37-40]		[41-44]
12,000.00	9,000	90	3,000	30
c. Range and wildlife				
10,000.00	7,000		3,000	
d. Improvements		[45-48]		[49-52]
2,765,200.00	171,600	1716	2,593,600	15957 9999
e. Other nontimber				
f. Total nontimber damage (a to e, incl.)		[53-57]		[58-62]
17,263,351.00	9,419,251	94193	7,844,100	78441
53. GRAND TOTAL DAMAGE (Items 51d and 52f)		[63-67]		[68-72]
17,263,351.00		94193		136854 99999

Remarks:

cc-State

Item 46 - This is not a coded figure. (Also #53 (63-67) not coded, Use uncoded $'s.

48-b - 2900 Chains Secondary Line Constructed by Tractors.

48-c - Air Attack on Key Portions of Lines to Insure Control 80 Miles of Perimeter.

49-a - 4000 Acres Outside National Forest Protection Boundary.
(Watershed Damage - $1,234,000.)

	DATE	SIGNATURE	TITLE
SUBMITTED →	12/21/64	/s/ Warren Barnes	District Ranger (or Acting)
APPROVED →	1/14/65	/s/ William H. Hansen	Forest Supervisor (~~or Acting~~)

GPO 884390

APPENDIX D

FIRE WEATHER OBSERVATIONS FOR

September 23 and 24, 1964 on the Coyote Fire

FIRE WEATHER OBSERVATIONS

Fire Coyote Date 9/23/64

Location	Elev	Time	Temp		RH	DP	Wind		Remarks
			Dry	Wet			Dir.	Sp.	
Westmont Camp	700	0400	65	55	53		N	1-2	
" " "	700	0435	68	55	43	25	N	2	
" " "	700	0708	69	55	40	44			
Power line & Hot Springs Canyon	115	1000	87	63	24		S	4	Fire beyond ridge
Westmont Camp	700	1030	88	62	21		WSW	6-8	
South Slope near top of Ridge	3400	1110	89	59	14		SE	5	
Water Tank on ridge	3500	1145	81	55.5	17		WSW	6	
Westmont Camp	700	1331	86	65	31		SE	3	
" " "	700	1430					SSE	0-2	
" " "	700	1647	87	66	32		SW	4	
" " "	700	1925	88	60	16		NNW	8-10	G25 5 min later
West of fire	Ridge	1930	74	52	20		NNE	25-35	G40
Santa Ana at	700	1940	80	61	28	46	NE	16-20	G30
Westmont Camp			90						
Westmont Camp	700	1954	83	61	27		SE	4	
" " "	700	1955	83	61	27		SE	4	St. NE winds abv.

FIRE WEATHER OBSERVATIONS

Fire Coyote Date 9/24/64

Location	Elev	Time	Temp Dry	Temp Wet	RH	DP	Wind Dir.	Wind Sp.	Remarks
Westmont Camp	700	0234	92	60	12	31	N	16	G 20
" " "	700	0515	91	60	13		N	6-8	G 12
" " "	700	0545	74	62	51		ESE	4-6	
Backfire "	1300	0640	86	59	17	36	NE		
" " "	1300	0647	88	61	19	40			
" " "	1300	0652	91	61	15	37			
" " "	1300	0658	89	60	15	36			
Saddle		0715	75	57.5	33	44	WSW	6	
Backfire		0735	71	59	49	51			
Saddle		0750	68	59	59	53			
Backfire		0805	70	60	56	54			
" "	1300	0830	72	60	50	52	NNE	6	
Beyond Saddle	1400	0910	90	62	18	41	VAR	6-8	
" "		0930	79	60	32	46			
Backfire		1120	87.5	63	24	46			
Westmont Camp	700	1418	84	64	32		V	1-2	Ac
" " "	700	1615	84	62	27		W	5	Acc SE-s TWRG Cu
La Cumbre Pk. L. O.	3750	1630	75	56	27		SW	12	Gusts to 18 High E winds
Gibralter Rd.	3900	1725	82	59	24				
La Cumbre Pk. L. O.	3750	1815	78	57	27	41	SE	12	
Westmont Camp	700	1850	75		45		V	1-2	Ac Cl
La Cumbre Pk. L. O.	3750	2200	69	54	38	43	W	2-3	
" " "	3750	2300	71	55	37	43	Calm		

APPENDIX E

DISASTER ABATEMENT AGREEMENT

DISASTER ABATEMENT

South Coast of Santa Barbara County

Revised 1961 at joint meeting with:

S. B. Co. Fire Dept. - V. A. Wadleigh, Chief
City of S. B. Fire Dept. - Roy Tenney, Chief
Montecito Fire District - Herb Ensign, Chief
Carpinteria Fire District - Frank Floyd, Chief
U. S. Forest Service - Warren Barnes, Chief Ranger

I. Statement of Need

The fire situation in the South coast of Santa Barbara County area, though not unique contains several factors that make the problem far from simple. These are:

1. The highly inflammable nature of the vegetation combined with critical summer fire weather in the areas immediately adjacent to the intensively developed centers of population on the coastal plain along the Santa Barbara front.

2. The situation is further aggravated by the continual extension of structural and other developments into areas completely surrounded by the highly inflammable vegetation.

3. There are five separate fire suppression agencies each with definitely assigned territories of responsibility but with these territories so situated that almost any wild fire in one zone immediately threatens the territory of one or more other agency.

4. The close association of large numbers of people and valuable improvements with serious fire threat requires the full utilization and coordination of all available resources within the area in order to promptly abate any disaster resulting from an uncontrolled fire.

The situation at Ojai in 1948 and the 1955 Refugio Fire are all too forceful examples of what can occur here. This plan, then, is designed to combat our problem. It will contain procedures for correlating the fire suppression skills, equipment and other resources of all fire suppression agencies and other facilitating groups to the end that, in case of serious fire, the least possible loss to tangible as well as intangible values will accrue and hardship to local residents shall be held to a minimum.

II. Agencies Involved and Responsibilities of Each

A. Primary (Firefighting)

1. U. S. Forest Service

The suppression of all uncontrolled watershed fires on all land within the boundary of Los Padres National Forest.

2. Santa Barbara County Fire Department

Fire suppression on all lands, property and improvements

outside of incorporated cities, incorporated fire districts, and the National Forest. Improvements within certain fire districts within National Forest.

3. Santa Barbara City Fire Department

Fire suppression on all lands, property and improvements within the city limits of Santa Barbara.

4. Montecito Fire Department

Fire suppression on all lands, property and improvements within the boundaries of the Montecito Fire District.

5. Carpinteria Fire District

Fire suppression on all lands, property and improvements within the boundaries of the Carpinteria Fire District.

B. Facilitation Agencies
County Sheriff's Department
California Highway Patrol
Santa Barbara City Police Department
American Red Cross
District and City Water Departments
County Health Departments
Utility Companies, i.e., light, gas and telephone
Transportation Companies
Employment Services
Newspaper and Radio Stations

All the above facilitating agencies are responsible for assisting within their respective fields and limits of their authority as their assistance is needed and requested by fire control agencies.

III. Plan of Action

A. Central Board of Strategy

1. When a fire burns or threatens to burn on land or improvements that are the responsibility of more than one agency to protect, a Central Board of Strategy will be established to meet continuously at an appropriate location until the fire is out.

2. The Board of Strategy shall be composed of an authoritative representative of each agency that is responsible for the fire protection in the particular area involved in any given fire. Fire agencies called in for assistance shall serve on the Board of Strategy in an advisory capacity.

3. Functions of the board. The board shall plan and cause to be executed all strategy for controlling the fire and abating disaster. No agency shall act independently of the board on overall strategy. The Board of Strategy shall have full control and command of fire-fighting forces and operations. Except that this does not prohibit a single agency from taking temporary emergency action in order to save life or improvements within its area of assigned responsibility.

B. Part to be played by facilitating agencies on Central Board of Strategy. It shall be the duty and privilege of the Board of Strategy to call on non-firefighting groups or individuals such as Red Cross, State Highway Patrol, etc., to assist within their respective fields and limits of their authority in the control of the fire and/or the abatement of the disaster. When the various facilitating groups are called for assistance it is the responsibility of the Central Board of Strategy to invite a responsible individual from each group to sit in, in an advisory and facilitating capacity.

C. Communication

It shall be the responsibility of each member or facilitator sitting on the Central Board of Strategy to establish reasonable and practical continuous communication facilities at the meeting place of the Central Board of Strategy so that decisions of the Board may be placed into effect without delay.

D. Report of Fire

When a report of a fire is received by a fire agency regardless of time of day or night and there is the least question as to the fire location being on that agencies area of responsibility, the agency receiving the report shall immediately relay the report to the agency on whose area the fire may be on or near.

There should be no delay occasioned by an attempt to confirm the fire and may involve reporting the fire to two or more agencies.

E. Mutual Aid

Prior to the establishment of the Board of Strategy and under conditions conducive to a disaster fire, a system of initial attack mutual aid shall be in effect. Such mutual aid may be initiated with or without request from the agency responsible and no charge back to the responsible agency shall be made.

Areas on which initial attack mutual aid by each agency is to be in effect is designated on attached maps.

Mutual aid other than that outlined above shall be covered by co-op agreement and cleared through the County Fire Coordinator when necessary.

APPENDIX F

FIRE ORGANIZATION, COYOTE FIRE

Date 9/23/64
Shift Day
6:00 AM - 6:00 PM

FIRE ORGANIZATION

Fire Boss Hickerson

Plans	
Plans Chief	Maule
Maps & Records	Miller
Intelligence	Heikes
Public Information	Parkinson
Fire Behavior	Revely
Safety Officer	Lord
Coordinator	Barnes

Service	
Service Chief	Russell
Air Service	Mansfield
Equip. Officer	Austin
Camp Officer	Netland
Supply Officer	Maitland
Communications Officer	Pogue

Finance	
Finance Chief	Burke
Time Officer	Millington
Compensation Officer	Baker
Obligation Officer	Burke
Claims Officer	Kinyon

Line Boss Lundgren

Div. Boss I Biedeback

Sec. Boss A	Sec. Boss B	Sec. Boss C
Thomas	White	Boggs
Men	Men	Men
50 Portervill	50 Port.	50
Pumpers	Pumpers	Pumpers
2	4	
Tractors	Tractors	Tractors
		2

Div. Boss II Marquez

Sec. Boss D	Sec. Boss E	Sec. Boss F
Cochran	Del John	Darr
Men	Men	Men
75 Port.	50 Port.	25 Port.
Pumpers	Pumpers	Pumpers
Tractors	Tractors	Tractors
1		6

Div. Boss III City-Fire Dist.

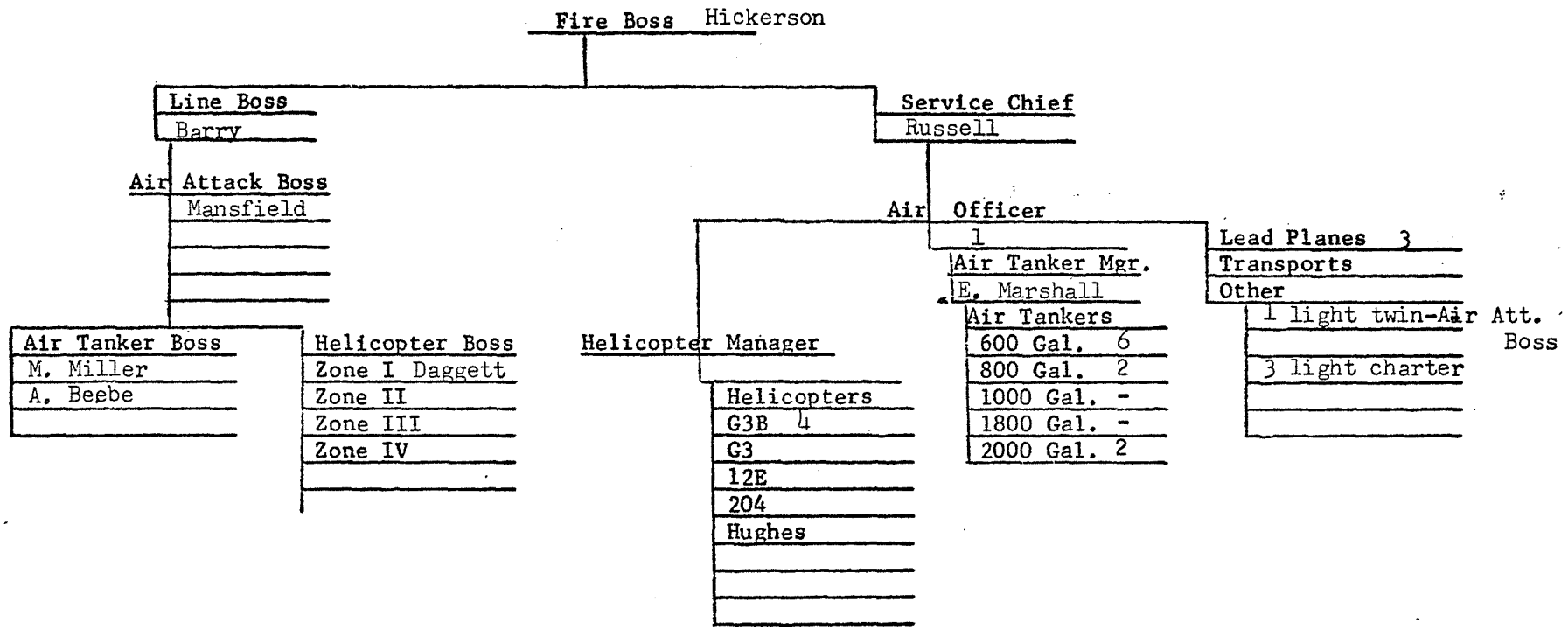
Sec. Boss G	Sec. Boss	Sec. Boss
Shaffer		
Men	Men	Men
37 Inmates		
Pumpers	Pumpers	Pumpers
4		
Tractors	Tractors	Tractors

Date 9/23/64

Shift Day
0730 - 1900

AIR ORGANIZATION

COYOTE FIRE



APPENDIX G

GENERAL HEADQUARTERS (GHQ) ORGANIZATION CHART, COYOTE FIRE

ZONE FIRE ORGANIZATION

ZONE NO. I

Date 9/27/64

Shift Day
6:00 AM to 6:00 PM

Zone Fire Boss McBride

Plans	Service	Finance
Plans Chief Dalen	Service Chief Blomstrom	Finance Chief Baker
Maps & Records Roether	Air Service	Time Officer
Intelligence	Equip. Officer Austin	Compensation Officer Worthington
Public Information	Camp Officer	Obligation Officer
Fire Behavior Decker	Supply Officer	Claims Officer Eckmeyer
Safety Officer Meik	Communications Officer	

Line Boss Biddison

Div. Boss II Lundgren			Div. Boss III Nelson			Div. Boss IV Petty		
Sec. Boss Mills	Sec. Boss Tonneson	Sec. Boss	Sec. Boss Boggs	Sec. Boss Shafer	Sec. Boss	Sec. Boss Criswell	Sec. Boss Benedictson	Sec. Boss
Men 25	Men 25	Men	Men 78	Men 26	Men	Men 42	Men 105	Men 105
Pumpers 7	Pumpers	Pumpers	Pumpers 4	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers
Tractors	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors 10	Tractors	Tractors 14

ZONE FIRE ORGANIZATION
ZONE NO. II

Date 9/27/64
Shift Day
6:00 AM to 6:00 PM

Zone Fire Boss Britton

Plans	Service	Finance
Plans Chief Janes	Service Chief Lewis	Finance Chief Lundeen
Maps & Records Harrell	Air Service Daggett	Time Officer Cinicero
Intelligence	Equip. Officer M. Roberts	Compensation Officer
Public Information	Camp Officer Fuqua	Obligation Officer
Fire Behavior Lust	Supply Officer	Claims Officer
Safety Officer Winters	Communications Officer	

Line Boss Clark

Div. Boss I Thomas - Vinson			Div. Boss II Hinton			Div. Boss III David		
Sec. Boss Priest	Sec. Boss	Sec. Boss	Sec. Boss Burrel	Sec. Boss	Sec. Boss	Sec. Boss Ward	Sec. Boss Kendall	Sec. Boss Parks
Men 80	Men 15	Men	Men 105	Men	Men	Men 105	Men 50	Men 50
Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers
Tractors 2	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors 2	Tractors

ZONE FIRE ORGANIZATION

ZONE NO. III

Date 9/27/64
Shift Day
6:00 AM to 6:00 PM

Zone Fire Boss Howard

Plans	Service	Finance
Plans Chief Biddison	Service Chief Blodgett	Finance Chief Davies
Maps & Records Vance	Air Service Ratledge	Time Officer Ferris
Intelligence Nunn	Equip. Officer Adams	Compensation Officer Dinwiddie
Public Information	Camp Officer McAllister	Obligation Officer
Fire Behavior Hardy	Supply Officer	Claims Officer
Safety Officer Warnock	Communications Officer	

Line Boss Garson

Div. Boss			Div. Boss			Div. Boss		
Sec. Boss Kennedy	Sec. Boss Robinson	Sec. Boss Scharff	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss
Men 70 Navy	Men 25	Men 63	Men	Men	Men	Men	Men	Men
Pumpers 3	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers
Tractors	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors	Tractors

ZONE FIRE ORGANIZATION
ZONE NO. IV

Date 9/27/64
Shift Day
6:00 AM to 6:00 PM

Zone Fire Boss Mansfield

Plans	Service	Finance
Plans Chief Turner	Service Chief Downing	Finance Chief Helmar
Maps & Records Dzurissin	Air Service Watson	Time Officer Porter
Intelligence	Equip. Officer Johnson	Compensation Officer
Public Information	Camp Officer	Obligation Officer
Fire Behavior Mutch	Supply Officer Houseman	Claims Officer
Safety Officer Coburn	Communications Officer Hayes	

Line Boss Berry

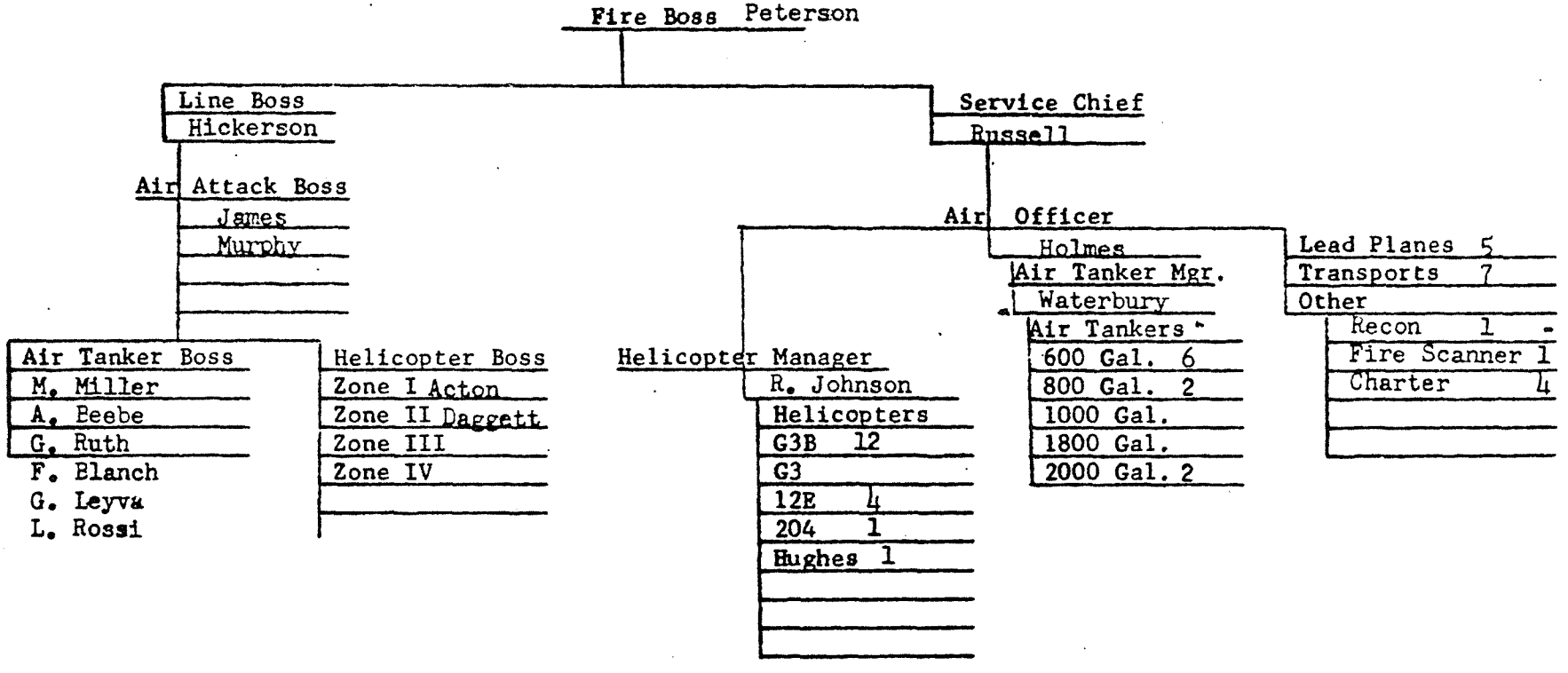
Div. Boss I Tracy			Div. Boss II Slaughter			Div. Boss		
Sec. Boss Fitzgerald	Sec. Boss Jordan	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss	Sec. Boss
Men 50 Navy	Men 57	Men	Men	Men	Men	Men	Men	Men
Pumpers	Pumpers 4	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers	Pumpers
Tractors 2	Tractors	Tractors	Tractors	Tractors 14	Tractors	Tractors	Tractors	Tractors

Date 9/27/64

Shift Day
6:00 AM to 6:00 PM

AIR ORGANIZATION

COYOTE FIRE



APPENDIX H

SELECTED FIRE WEATHER FORECASTS AND FIRE BEHAVIOR FORECASTS, COYOTE FIRE

Southern California Fire Weather Mobile Unit

Forecast For Coyote Fire, Los Padres National Forest

Forecast No. 1, Wednesday, September 23, 1964

General: High pressure western U.S. surface and aloft continues to dominate weather picture.

Temperatures: Slightly warmer than yesterday. Maximum in middle 80s.

Humidity: From a high of about 50 before daybreak humidity will drop during day to 20 to 25 percent.

Wind: Over higher ridges will continue mostly from northeast to east 8 to 15 mph. In lower fire area variable direction in morning 2 to 6 mph, becoming mostly SW 6 to 10.

Stability: Air will continue fairly stable, if anything slightly more stable than yesterday.

George Ellis and Don Lust
Fire Weather Forecasters

Fire Behavior Forecast No. 1, Day Shift, September 23, 1964

General: Since northeast winds are expected to affect only the ridge top and are not expected to get down into the fire area, and the air mass will be comparatively stable, no unusual fire activity is expected today.

Sectors A, B, D & G- Fire spread will be responding primarily to topography during the forenoon, and will be aided in its upslope spread by the south to southwest winds in the afternoon. Greatest pressures will be on sectors E and G. Where fire burns hot enough to get burning embers up to 5000 feet the embers will be carried to the west by strong easterly winds above that level.

Outlook: From present indications we do not expect a repeat of last night's winds, but since the surfacing of northeast winds during the evening hours is characteristic of Santa Ana situations we must recognize that it is at least a remote possibility.

Mark J. Schroeder
Fire Behavior Officer
0530 PDT September 23, 1964

Forecast No. 2, Night of Wednesday-Thursday, September 23-24, 1964

General: Strong upper-level high-pressure area continues to dominate weather, bring abnormally high temperatures and low humidities to the fire area.

Temperature: Lowering after sunset to a minimum of 65 in camp and to about 70 at the ridge top.

Humidity: Rising to a high of 50% in camp and low levels, and a high of 35% along ridge tops.

Winds: Over ridges, East to Northeast 17 to 24. Downslope winds 3 to 7 beginning by 10 pm. In Santa Ynez Valley downvalley mostly easterly 3 to 7. While the probability of a recurrence of the strong E winds that blew last night for a while is slight, the possibility cannot be completely ruled out tonight. Personnel should be aware of this possibility.

Outlook: Slightly higher temps Thursday with the high in the low 90's and Humidity at camp level slightly lower in 15-20% range and little change along ridges. Continued East to Northeast winds in the higher levels.

George Ellis, Donald Lust
Fire Weather Forecasters

Fire Behavior Forecast No. 2, Night Shift, September 23, 1964

General: Because of the dense and dry fuels and steep topography, rather hot runs can be expected thru the night, particularly at higher levels.

Sectors A and east side: With light downslope winds fire will gradually eat away fuels to west along sector A and to the east along east side in short upslope runs which become hotter above about 2000 feet, the top of the night time inversion.

Sectors F and G: In the Santa Ynez drainage where fuels are especially heavy short but hot runs can be expected. With easterly drainage winds in this area spread along sector F will be more rapid.

Caution: Strong northeasterly winds still exist aloft although the layer has been raising since morning. The odds are against these winds surfacing like they did last night, and driving the fire into residential areas, but there is something like a 10% chance that this could happen.

Outlook: Little change in fire activity Thursday except that downslope winds in the afternoon on north-facing slopes are likely.

Mark J. Schroeder
Fire Behavior Officer
1558 PDT September 23, 1964

AMENDED FORECAST FOR NIGHT SHIFT OF
9/23/64

Sequence of events evening of 23 September relative to surfacing of Santa Ana winds on Coyote Fire:

Although the forecast for the night shift indicated a small probability of the wind surfacing, John Dell was sent to ridge to watch for indications.

Dell recorded north-northeast winds of 20 mph with gusts to 35. Temperature was 86 and relative humidity 14. This report was sent to me by radio at 1915 PDT. The time of the observation was 1900.

At 1930 I notified the Fire Boss that the Santa Ana winds would surface in a manner similar to the previous night. He got on the radio immediately to notify men on the line of this and asked them to take precautions.

At 1940 the northeast winds were felt at the fire camp. Temperatures rose abruptly and humidity dropped as the winds picked up to 16-20 mph with gusts to 30. These conditions continued thru the night until about 0545.

Mark J. Schroeder
Fire Behavior Officer

Forecast No. 3, Thursday, September 24, 1964

General: Santa Ana condition has intensified and shows no sign of weakening today.

Temperature: Slightly warmer today. High temps middle 90s all levels.

Humidity: Very low, 10 to 15 percent in morning probably improving slightly to 15 to 25 in afternoon.

Wind: Continued strong Santa Ana winds. Mostly NE to E 12 to 20 exposed low levels and 15 to 35 over exposed ridges, gusty all levels. Some decrease in low-level winds in PM, direction becoming variable, mostly easterly, 0 to 15 mph. Wind continuing strong over high ridges.

Cautions: Air has become unstable allowing stronger vertical motion encouraging gusty erratic winds and strong convection.

Outlook: No relief in sight as far as large-scale weather pattern goes. Probably less windy tomorrow.

G. Ellis and D. V. Lust
Fire Weather Forecasters

Fire Behavior Forecast, No. 3, Day Shift, September 24, 1964

General: Strong Santa Ana conditions will continue at high levels but will weaken at low levels during day. Fuels are very dry and dense, and hot runs can be expected wherever favored by winds or topography. Atmospheric instability will favor the development of large convection columns, spotting, and firewhirls.

South Side: Santa Ana winds should lift during day allowing some onshore and upslope winds and permit control action.

Santa Ynez Drainage: Santa Ana winds will decrease in lower levels during day but continue from northeast and east direction at high levels. This should decrease fire activity on west side except by button-hooking and running upslope. It will also permit fire to run rapidly and hot up north side of drainage wherever it crosses bottom. Hot runs can be expected on east side. At higher levels where Santa Ana winds remain strong continued fast spread to west can be expected.

West Side of Santa Barbara Front: Decreased fire activity at low levels, westerly spread at high levels.

East Side of Santa Barbara Front: Hot upslope runs aided by upslope winds and possible lee eddies in lower levels, Santa Ana winds opposing eastward spread at higher levels.

Cautions: All should be aware by now that this is a critical fire situation and should take necessary precautions.

Outlook: Santa Ana winds are again likely to surface tonight.

Mark J. Schroeder
Fire Behavior Officer
0400 PDT September 24, 1964

Forecast No. 4, Night of Thursday-Friday, September 24-25, 1964

General: Offshore gradient is weakening. Considerable moisture is coming into area from upper low over Arizona. Showers and thunderstorms are occurring in San Diego and San Bernardino Counties.

Temperature: Continued rather warm, but not as warm low levels as last night. Min Temp Westmont College high 70s and about same at 3500 ft. level.

Humidity: Except for possible periods of downslope winds during night when humidity would lower to 15-20 percent at low levels, humidity will remain in 40 to 60 percent range low levels; at 3500 foot level humidities will remain rather low, about 18 to 25 percent.

Wind: Decreasing easterly wind over ridges, mostly 7 to 15 mph and becoming more variable in direction. While there is still a possibility of strong northeast winds surfacing at low levels as they did last night, the chances are considerably less, and if this does occur the period of wind will be less and the winds not as strong. Night-time drainage winds in canyons poorly developed due to cloud and smoke cover.

Notes: Considerable increase in moisture aloft. Air continues quite unstable.

APPENDIX I

DOCUMENTS AND RECORDS ON FILE

APPENDIX I

DOCUMENTS AND RECORDS ON FILE
(National Fire Coordination Study)

1. "Fire Problems of California." Transcript of Hearing of the Senate Fact Finding Committee on Natural Resources, Fred S. Farr, Chairman. Held in Santa Barbara, October 15, 1964. 146pp.

2. "Administrative Fire Analysis--Coyote Fire" September 22-October 1, 1964. Los Padres National Forest, Santa Barbara, California, March 30, 1965. 108 pp, App.

3. "Wildland Development Fire Protection Master Plan." A Report of the Technical Agencies Subcommittee on Wildland Fire Protection to the City-County Relations Committee, Southern California Regional Association of County Supervisors. Preliminary Draft. October 9, 1964. 25pp.

4. Report of Committee on "Study of Controlled Burning Program as Fire Prevention Measure," Santa Barbara, California, December 3, 1964. Committee appointed by Santa Barbara County Board of Supervisors. 13pp.

5. "General Review and Information for the Office of Civilian Defense" for Coyote Fire September 22-October 1, 1964, by Los Padres National Forest. May 18, 1965. 3pp. plus attachment.

6. "Fire Behavior Coyote Fire." Forest Fire Laboratory, Riverside, U.S. Forest Service. Rough Draft. October 9, 1964. 30 pp. (weather data and fire weather and fire behavior forecasts).

7. "Narrative Fire Report, 1964 Fire Season, Region 5." U.S. Forest Service, San Francisco, December 16, 1964. 20pp.

8. "Recommendations, Regional Fire Analysis Committee R-5, 1964 Season." U.S. Forest Service, San Francisco. May 17, 1965. 8 pp. (stemming primarily from Coyote Fire.)

9. "Comments on Analysis of Coyote Fire." Memorandum from M.S. Lowden to Deputy Chief of the Forest Service. April 1, 1965. 6 pp.

10. "Dispatching Systems." U. S. Forest Service and California Division of Forestry.

11. "Sample Computation of Control Force Needs." Coyote Fire - September 22, 1964.

12. "Logistics and Action Timing - Coyote Fire." Notes prepared to T. G. Storey.

13. "Sample Communication Diagram and Description." Coyote Fire, Friday, September 25, Saturday, September 26.

14. "Newspaper Accounts of Coyote Fire."
Santa Rosa Press-Democrat: 9/23/64
San Francisco Chronicle: 9/23, 24, 25, 26/64.